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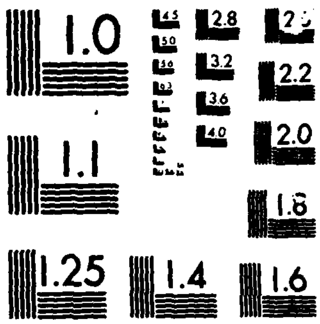

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PROJECT EXECUTION PLAN FOR THE INSTALLATION OF UNDERWATER POWER CABLES TO SMITH ISLAND, CAPE FLATTERY, AND DESTRUCTION ISLAND LIGHTHOUSES

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removal of all Coast Guard personnel from these outposts. CHESNAVFACENGCOM support for this project comprises the installation of underwater power cable to a number of these lighthouses that have offshore locations and which priorities demand should be powered from shore power sources rather than from untended diesel generators in each lighthouse. CHESNAVFACENGCOM has already conducted feasibility studies, analyzed costs, investigated sites, surveyed cable routes, procured cable, furnished project management, and installed cable for several of the lighthouses being converted under this modernization program.

The current project involved the installation of power cables to three lighthouses within the jurisdiction of th 13th Coast Guard District. This District, headquartered in Seattle, Washington, is in the process of automating two manned, offshore lighthouses, and in converting one offshore lighthouse presently unmanned to shore power.

PROJECT EXECUTION PLAN FOR THE INSTALLATION OF UNDERWATER POWER CABLES TO SMITH ISLAND, CAPE FLATTERY, AND DESTRUCTION ISLAND LIGHTHOUSES

OCEAN FACILITIES ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION, NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D. C. 20374

1 SEPTEMBER 1976

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1.0 OVERALL PROJECT DESCRIPTION

1.1 OVERVIEW

The Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) provides support for the U. S. Coast Guard Lighthouse Automation and Modernization Program (LAMP). The ultimate goal of LAMP is the total automation of all Coast Guard lighthouses, thus permitting the removal of all Coast Guard personnel from these outposts. CHESNAVFACENGCOM support for this project comprises the installation of underwater power cable to a number of these lighthouses that have offshore locations and which priorities demand should be powered from shore power sources rather than from untended diesel generators in each lighthouse. CHESNAVFACENGCOM has already conducted feasibility studies, analyzed costs, investigated sites, surveyed cable routes, procured cable, furnished project management, and installed cable for several of the lighthouses being converted under this modernization program.

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1.2 INSTALLATION SITES

The currently manned lighthouses are on Tatoosh Island and on Smith Island; the former is off Cape Flattery at the entrance to San Juan Straits and the latter is located off Whidbey Island at the eastern end of the Straits in Puget Sound. The lighthouse that has already been automated, but which is to be converted to shore power, is located on Destruction Island; this island is off the west coast of Washington State about 60 miles south of Cape Flattery. These three sites are indicated on the map, Figure 1, and the tabulation below, extracted from the Coast Guard Light List, provides some additional description of these lighthouses.

(1) No.	(2) Name / Characteristic	(3) Location / Lat. N. / Long. W.	(4) Nominal Range	(5) Ht. above water	(6) Structure / Ht. above ground / Daymark	(7) Remarks / Year
WASHINGTON						THIRTEENTH DISTRICT
2249 04770	Smith Island Light Fl. W., 15s	In east end of strait 48 19.1 122 50.6	20	97	White square daymark on skeleton tower. 45	RADIOBEACON: Antenna 310 feet 355° from light tower. See p. XVIII for method of operation. 1858–1957
107 2220 04756	CAPE FLATTERY LIGHT Gp. Fl. W., R. sector, 45s 0.2s fl., 7.3s ec. 0.2s fl., 7.3s ec. 0.2s fl., 29.8s ec. 3 flashes.	On Tatoosh Island, south side of entrance to Strait of Juan de Fuca. 48 23.5 124 44.1	22W 18R	165	White conical tower on white sandstone dwelling. 65	Red from 164½ to 171°, covers Duncan and Duntze Rocks. Light obscured from 271° to 007½°. RADIOBEACON: Antenna 290 feet 012° from light tower. See p. XVIII for method of operation. HORN, 2 blasts ev 60s (3s bl-3s si-3s bl-51s si). 1857
103 04746	DESTRUCTION ISLAND LIGHT Fl. W., 10s (Chart 6102) (NO 18100)	On southwest part of island. 47 40.5 124 29.1	24	147	White conical tower with black gallery. 94	HORN, 1 blast ev 30s (3s bl). Emergency light E. Int. W., 6s. 1891

1.3 PRIOR PREPARATION FOR CABLE INSTALLATION

In preparation for the cable laying activities associated with this project, a site investigation at each of the three lighthouses was conducted during the week of 20 October 1975. The report of this investigation is given herein in Appendix B. Also, between 20 and 26 June 1976, the underwater cable routes for each of these sites were surveyed in accordance with the procedures described in Appendix A. In lieu of reporting separately the survey results, data on the underwater cable routes applicable to the installation phase of the project are covered in this Project Execution Plan in the sections dealing with each individual site.

1.4 CABLE AND PROTECTION SYSTEMS

As delineated in Appendix B, the power cable requirements for the three sites are approximately: Cape Flattery - 40,000 feet; Smith Island - 34,000 feet; Destruction Island - 40,000 feet. The total, which includes a 10% allowance, is 114,000 feet.

There is presently available some 100,000 feet of surplus armored coaxial communications cable (see Appendix B, Attachment 1, page B-8) which has been determined to satisfactorily meet the power cable requirements. This cable is stored at the U. S. Coast Guard Base, Astoria, Oregon, on 3000 foot reels

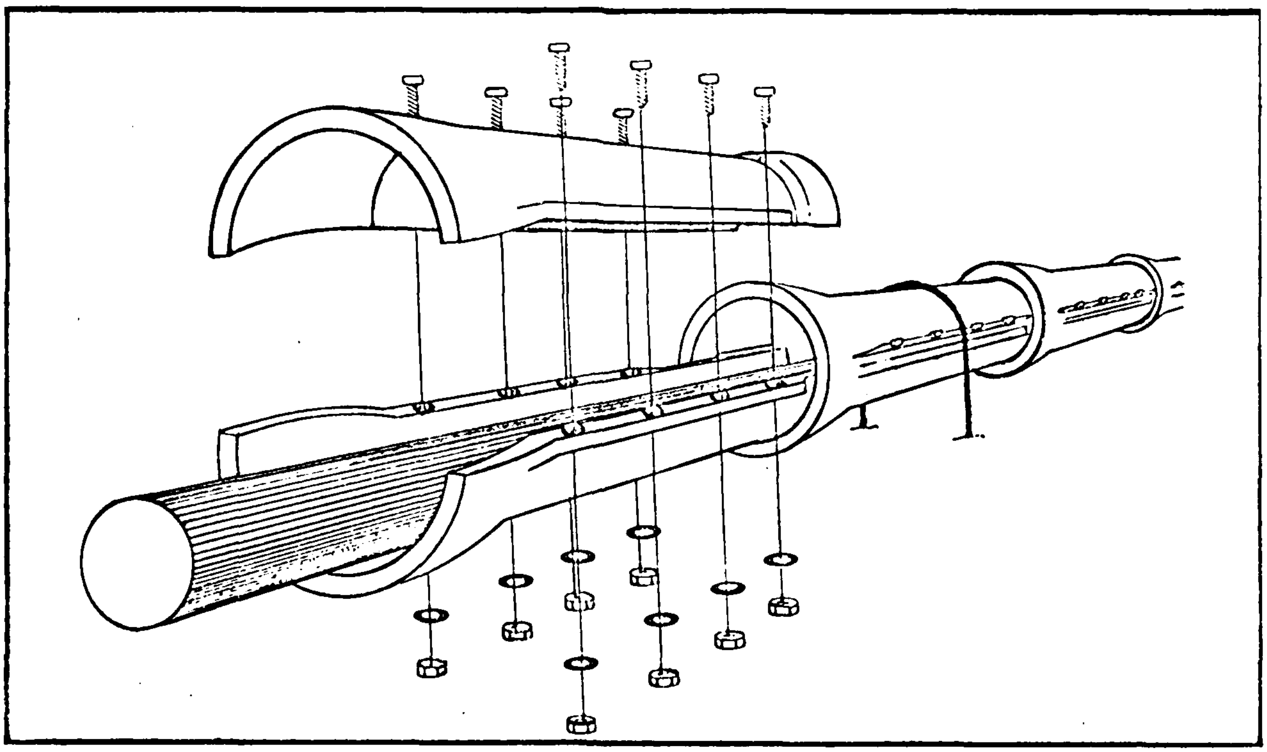
and it is planned to utilize about 80,000 feet of it for the Smith Island and Destruction Island installations. This cable will be spliced at Astoria into one continuous length prior to stowing it aboard the cable-laying vessel.

Additionally there is available some 60,000 feet of used, ITT, double-armored power cable (see Appendix B, Attachment 2, page B-9) which it is planned to use for the Cape Flattery installation. This cable has been shipped to Astoria, Oregon for the project; only two splices will be required to provide the continuous 44,000 foot length to be stowed aboard the cable-laying vessel. The excess cable is for contingency purposes.

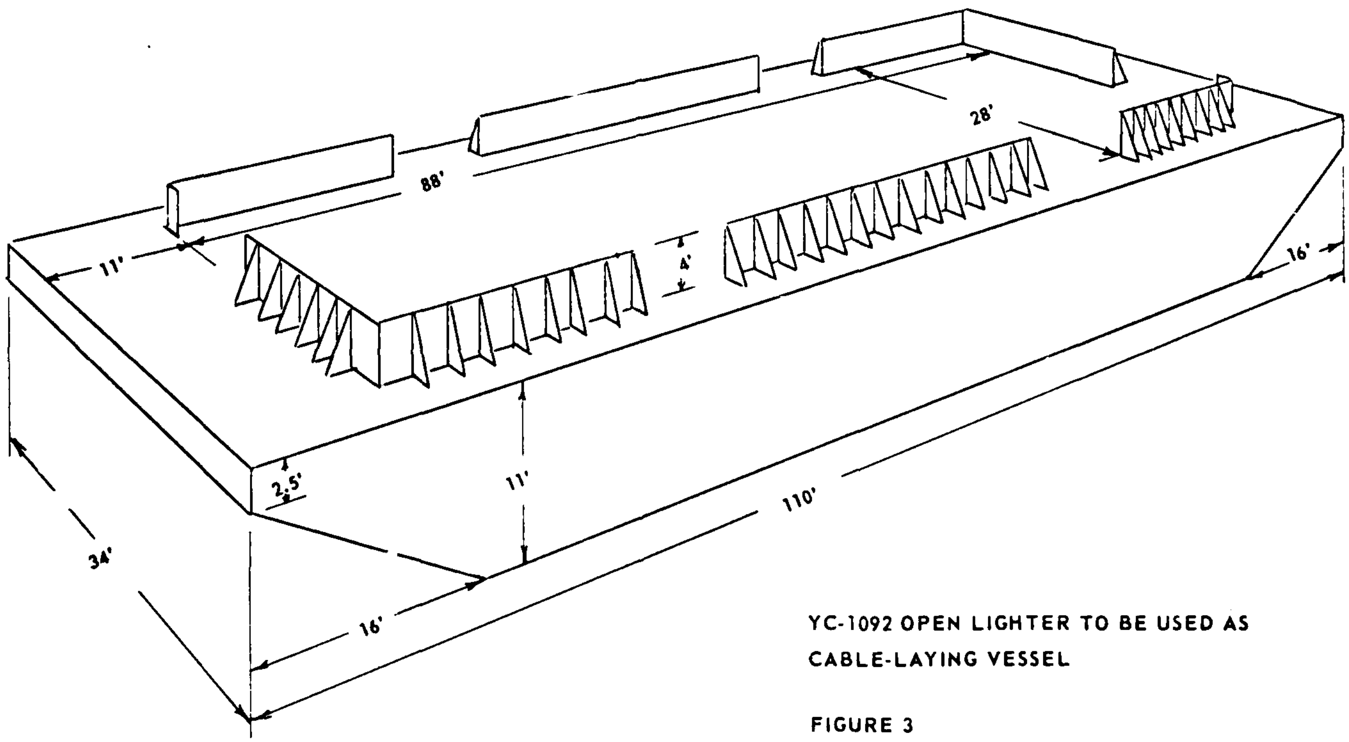
A system for stabilizing and protecting cable running from a beach into deep water over a rocky bottom was worked out a number of years ago by Western Electric. The system, Figure 2, consists basically of encasing the cable inside a series of interlocking sections of split pipe and anchoring the pipe to the bottom with U-bolts or with threaded rods running through the flange-bolt holes. The split pipe is of nodular cast iron; standard patterns are available with inside diameters of 3.5 or 5.0 inches and a length of three feet.

TYPICAL SPLIT PIPE FOR
CABLE PROTECTION AND STABILIZATION

FIGURE 2



Each pipe section is made up of two flanged halves that can be bolted together to encase the cable. One end of each section is belled out to form a socket and the other end is shaped into a ball configuration to fit into the contiguous section allowing an angular misalignment of about 7.5°. Many protection systems of this type have been installed by the Underwater Construction Teams (UCT) of the U. S. Navy Construction Battalions (SeaBees) and the operation is now fairly standard practice for these groups. A team of UCT-2 divers from the 31st Naval Construction Regiment at Port Hueneme, California has been assigned to this project to perform the cable immobilization work. About 100 lengths of split pipe will be loaded aboard the cable-laying vessel at Astoria.



YC-1092 OPEN LIGHTER TO BE USED AS CABLE-LAYING VESSEL

FIGURE 3

1.5 CABLE-LAYING PLATFORM AND SUPPORT VESSELS

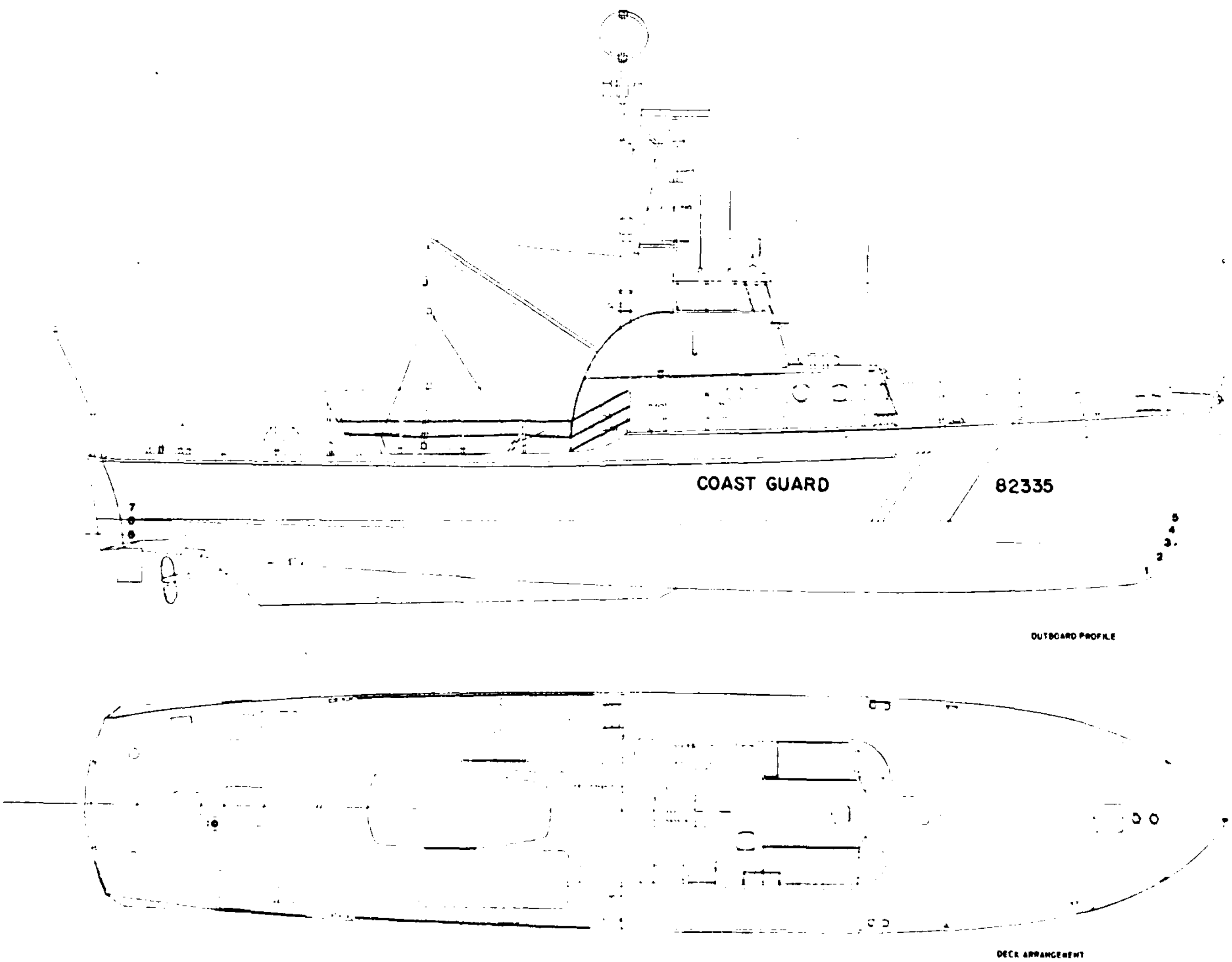
The cable-laying platform will be a 500-ton open lighter, designated YC-1092. This vessel, Figure 3, is on loan from the Naval Torpedo Station, Keyport, Washington and will be towed by the Coast Guard to the U. S. Coast Guard Station at Astoria, Oregon to be modified to cable-laying and to have loaded aboard the gear necessary for the operation.

This 110 foot x 34 foot x 11 foot lighter has an open deck area 88 feet x 28 feet that is surrounded by a four foot high bulwark, stiffened on the

outboard side to form a clear space without obstructions for stowage of the cable and other gear required for the operations. The cable-laying gear to be installed in the after end of this open space consists of a Cable Laying and Maintenance Machine, CLAMM, which has been developed by the Coast Guard as described in Appendix C. The forward 58 feet of the space between bulwarks will be occupied by the cable looped into 21 layers with 48 cable loops per layer. Over the center of the stowed cable, a sheave will be hung from a cable-stayed steel frame that spans the open space. During the laying operation the cable will pass from the stowage area, up and over the suspended sheave, down around the CLAMM winch drum, through a brake system and chute down over the stern into the water. Variations on this system will be described in greater detail in a later section.

U. S. COAST GUARD 82' PATROL BOAT

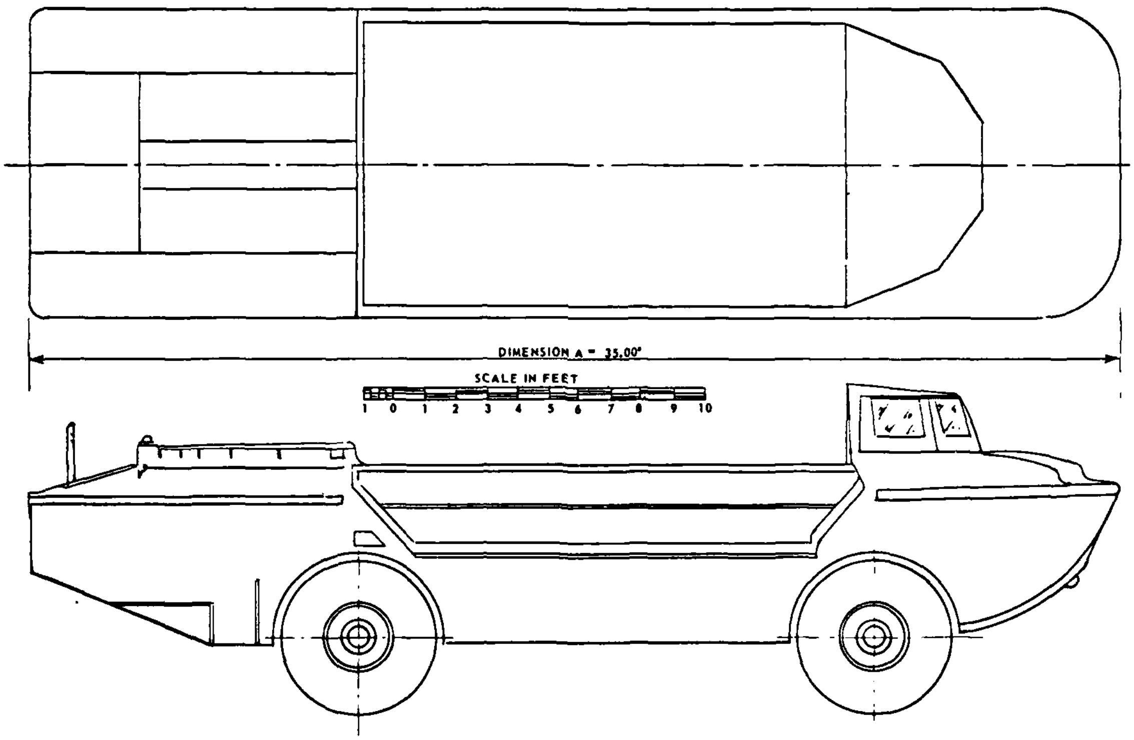
FIGURE 4



The YC-1092 will be towed from Astoria to the three installation sites, and also towed during cable-laying operations, by the U. S. Coast Guard 82-foot, Patrol Boat, *POINT COUNTESS*, WPB-82335, Figure 4. The 64 ton, twin screw, 1,600 horsepower vessel has a free running speed of more than 22 knots and has the ability to tow the lightly loaded YC-1092 at speeds in excess of 10 knots. The *POINT COUNTESS* operates under the control of the 13th Coast Guard District and will be assigned to LAMP throughout the duration of this project.

tender

The Navy will assign a LARC V amphibious craft, Figure 5, to this project for use during cable immobilization operations as a diver support boat.



LIGHTER, AMPHIBIOUS, RESUPPLY, CARGO: LARC V

FIGURE 5

Details of the capabilities of this platform are included in Appendix D. It is anticipated that the LARC V will transit overland, or by commercial ferry to the three installation sites. However, ramps will be required to ease its entry into the water at each of the sites. The Navy will also assign an inflatable ZODIAC craft for additional support of these operations as required.

OVERALL SCHEDULE OF OPERATIONS

FIGURE 6

OPERATION	FROM	T-42	T-39	T-32	T-23	T-1	T	T+3	T+7	T+12	T+13	T+16
	TO	T-40	T-33	T-24	T-2		T+2	T+6	T+11		T+15	T+22
YC-1092 TOWED FROM KEYPORT TO ASTORIA		▲										
OUTFITTING OF YC-1092 FOR CABLE LAYING			▲									
PREPARATION OF YC-1092 FOR CABLE LOADING				▲								
LOADING OF CABLE AND DEPARTURE PREPARATION					▲							
TRIALS OF EQUIPMENT AND TECHNIQUES						▲						
TRANSIT FROM ASTORIA TO NEAH BAY							▲					
CABLE LAYING - NEAH BAY TO TATOOSH ISLAND								▲				
CABLE LAYING INSHORE FROM DESTRUCTION ISLAND									▲			
TRANSIT OF PLATFORMS TO PORT ANGELES, WASHINGTON										▲		
CABLE LAYING - SMITH ISLAND TO WHIDBEY ISLAND											▲	
DEMOBILIZATION AND OFF-LOADING AT SEATTLE												▲

The Coast Guard intends to provide the services of a 42-foot high speed search and rescue boat (SAR) for assistance in handling the YC-1092, for necessary runs into port, and for emergency use. A TICWAN craft will be supplied by the Coast Guard for inshore diver support at Neah Bay and the 14-foot Boston Whaler carried aboard the *POINT COUNTESS* will be available as needed. General characteristics of this latter craft can also be extracted from the data given in Appendix D.

1.6 OVERALL SCHEDULING OF THE PROJECT

The schedule given in Figure 6 is tentative and is subject to changes that are dependent upon:

- Completion of cable splicing and loading aboard the YC-1092 cable-laying vessel.
- Availability of UCT-2 divers from the 31st NCR.
- Weather and sea conditions at installation sites.

General scheduling of the operation is covered here with additional details provided in the later coverage of each operational aspect. In Figure 6 all days are referred to day T, the departure of the cable-laying platform under tow from Astoria to Neah Bay.

2.0 ORGANIZATIONAL RESPONSIBILITIES

2.1 CHESNAVFACENGCOM

The Chesapeake Division of the Naval Facilities Engineering Command is under an interagency agreement with U. S. Coast Guard Headquarters in Washington, D. C., to provide underwater power cable installations for various Coast Guard districts. For the cable installations to Smith Island, Cape Flattery, and Destruction Island, CHESNAVFACENGCOM will provide:

- Overall project engineering, management, and coordination.
- Inter-communication between all project participants.
- Navigation equipment and procedures.
- A project manager, assisted by a CHESNAVFACENGCOM engineer.
- Documentation, including a final report.

The contact is: CHESNAVFACENGCOM
Building 57, Washington Navy Yard
Washington, D. C. 20374
202-433-3881 (Autovon 288-3881)
Code FPO-1C3 Hal Dorin

2.2 13TH COAST GUARD DISTRICT

The 13th Coast Guard District is actively involved in the support of all phases of this project. For the cable installation, the 13th Coast Guard District will:

- Provide the support of various Coast Guard Stations within the District and District Headquarters.
- Tow the cable-laying platform from Keyport to Astoria, Oregon for loading cable and from Astoria to the installation sites.

- Outfit the cable-laying platform, including the CLAMM.
- Splice and load the cable aboard the platform.
- Tow the cable-laying platform during cable-laying operations.
- Provide additional support vessels as required.
- Be responsible for burying and/or protecting the cable at each cable landing site, from water level up the beach to the lighthouse or the power source.
- Provide site clearances for access to the lighthouse islands and the proposed shore power terminal areas.
- Provide a representative to serve as liaison between the Coast Guard and Navy (CHESNAVFACENGCOM and UCT-2).
- Provide specific miscellaneous items such as fire hose or other material to shim the cables inside the split pipe (UCT-2 will notify the 13th Coast Guard District of hose or material size).

The contact is: Thirteenth Coast Guard District
Civil Engineering Branch
915 2nd Avenue
Seattle, Washington
206-442-5807
LT Greg Magee

2.3 UNDERWATER CONSTRUCTION TEAM - TWO (UCT-2)

UCT-2 has been able to schedule support for the planned September and/or October installations of the three cables. UCT-2 will:

- Provide a 12-man diving and construction team with the necessary diving, other support equipment, and supplies.
- Provide a LARC V Amphibious Craft for use as a diving and construction platform and for assistance during cable-laying.
- Provide personnel to assist with cable-laying and navigation.
- Notify 13th Coast Guard District of "size" of fire hose or other material required to shim both the 1.5" and 1.1" diameter cables inside intended 3.5" split pipe.
- Protect and stabilize cable as required at each of the shore approaches.
- Provide specific equipment such as rock bolts and the equipment and supplies to "rock bolt" the split pipe assemblies; reusable float balloons; etc.

- Provide navigation equipment, such as a portable depth recorder, transits (2), and tripods for transits (2).
- Prepare written report (with underwater photographs) of the diving aspects of the installation.

The contact is: Thirty-First Naval Construction Regiment
Underwater Construction Team - Two
Port Hueneme, California 93041
805-982-5911 (Autovon 360-5911)
LT Bill Walker

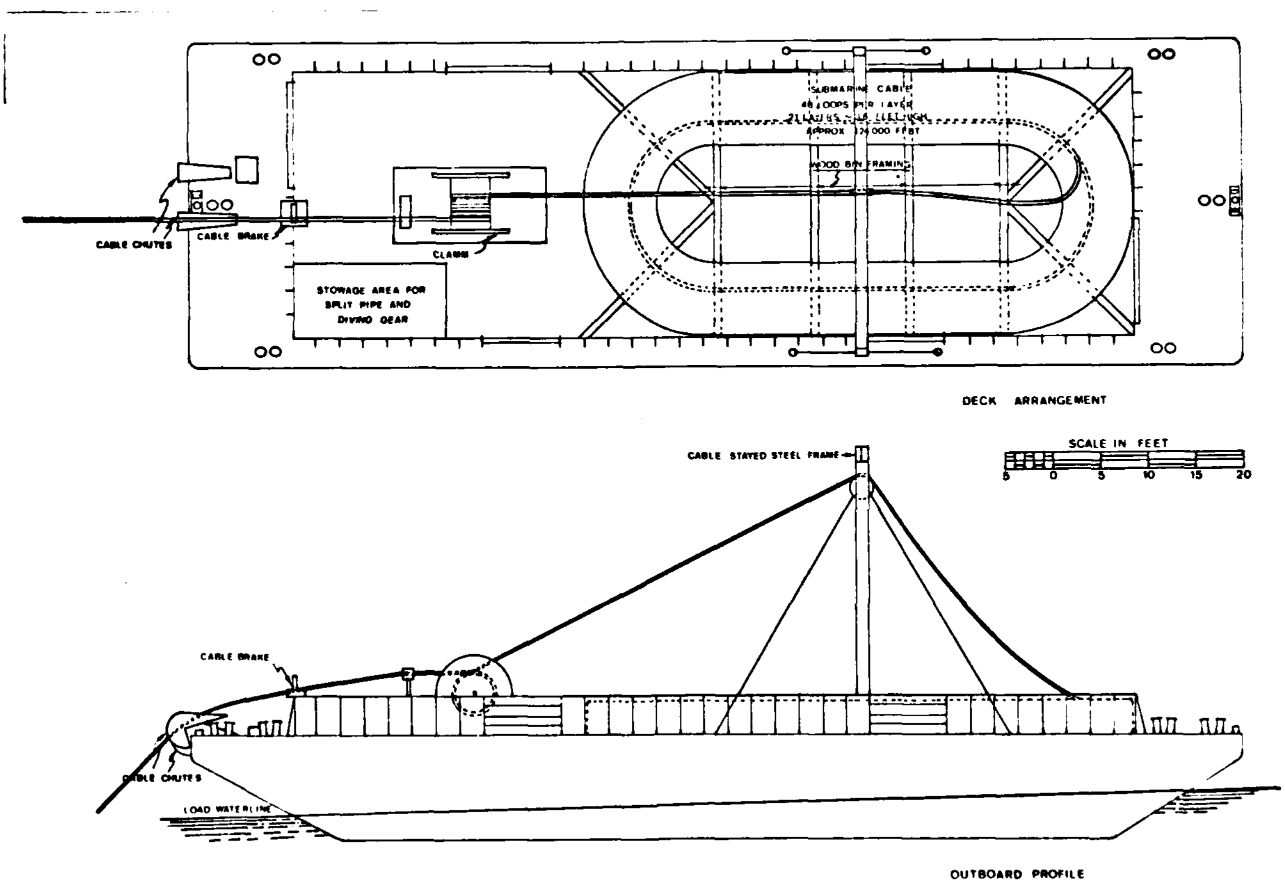
3.0 OUTFITTING AND LOADING THE CABLE-LAYING PLATFORM

3.1 INSTALLATION OF CABLE-LAYING EQUIPMENT

The equipment required aboard the YC-1092 for cable-laying operations is best described by reference to Figure 7.

YC-1092 RIGGED FOR CABLE-LAYING OVER BULWARK

FIGURE 7



A steel H-beam frame is to be constructed by the Coast Guard and installed 29 feet aft of the forward bulwark. The two 30-foot high legs are bolted to the deck outboard of the bulwark and are each stayed fore and aft by steel cables. The 31-foot long cross beam, which spans the cable bay, has welded end plates drilled with holes for attachment bolts to secure the beam to the vertical legs at a series of different heights above the deck. This permits the sheave, which is suspended from the center of the cross beam, to be positioned vertically for optimum alignment of the cable.

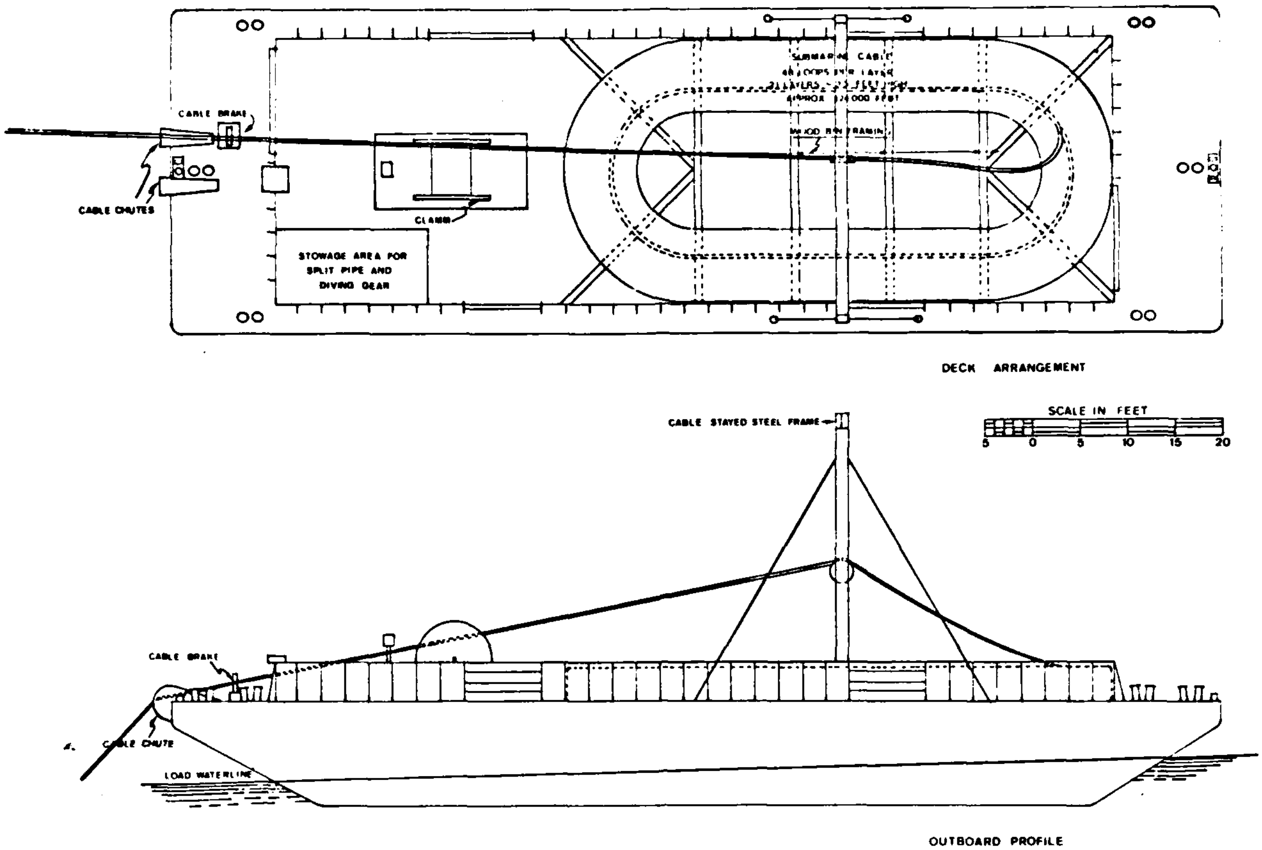
Prior to installing the H-beam frame the barge will be cleared of all debris. All deck fittings within the area surrounded by the bulwark will be cut away and welds ground smooth. All tanks will be inspected, pumped dry, and manhole covers secured. Any remaining wood sections covering the bulwark openings will be removed and stored ashore.

The Cable Laying and Maintenance Machine, CLAMM, described in Appendix C, will be located on the deck centerline as shown in Figure 7, with the level-wind fairlead on the after side, and securing legs installed.

Two cable chutes, provided by the Coast Guard, will be installed along the after rake end deck edge. As indicated in the drawing, one chute will be approximately on centerline, braced and secured beside the chock and bitts so that these fittings will be accessible; this centerline chute is to align with cable being payed out over the bulwark. The second chute will be off center to port and will be welded flush to the deck; it is to align with cable being payed out across the CLAMM drum and through the after opening in the bulwark as shown in Figure 8.

Only one cable brake, to be furnished by the Coast Guard, is available for installation on the YC-1092. Two mounting pads for this brake are required. One will be welded to the top of the after bulwark, approximately on centerline, in line with the centrally located cable chute. The other mounting pad will be located, approximately as shown in Figure 8, where the brake will be in line with the cable passing over the CLAMM drum and through the bulwark.

All necessary navigation lights, including running lights, anchor lights, and towing lights, are to be installed by the Coast Guard. It may be noted that, because of the trim the vessel will assume when the cable is loaded forward, the platform will be towed astern from Astoria to Neah Bay. However,



YC-1092 RIGGED FOR CABLE-LAYING THROUGH BULWARK

FIGURE 8

it will be towed ahead during cable-laying operations. Any necessary adjustments in navigation lights required for these two operational modes should be made when the light system is installed. Floodlights should also be provided as required for night-time operations.

3.2 PREPARATION OF PLATFORM TO STOW CABLE

As shown in Figure 7 and 8, the cable stowage bin covers the forward 58 feet of the main deck area enclosed by the longitudinal bulwarks and the forward transverse bulwark. The outer loop of cable has straight runs of 30-feet fore and aft along the inside of the longitudinal bulwarks connected by semi-circular runs, of 14-foot radius, at the forward and after ends. The inner loop of cable has straight runs of 30-feet fore and aft spaced 12-feet apart connected by semi-circular runs, of 6-foot radius, at the forward and after ends. Assuming a two inch center spacing of the cable loops this arrangement will accommodate 48 loops per layer. The outer loop length will be 147 feet of cable and the inner loop will be 98 feet of cable. There will be 21 layers of cable.

The bottom layer of cable will be supported off the deck by 2 x 6 timbers laid flat. As shown in Figure 8, these comprise four 28-foot lengths running athwartships between the bulwarks and four 19-foot lengths running diagonally along the deck. Diagonally braced vertical timbers will be erected at each of the four corners to configure the outer loops of each layer; these will be braced from the bulwarks as necessary. The inner loop of the first layer will be configured around blocks nailed to the flat athwartships and diagonal 2 x 6 timbers. For successive layers, temporary verticals will be attached to the base units so that they extend slightly above each layer as it is laid to ensure control of the configuration of the inner loop of the layer.

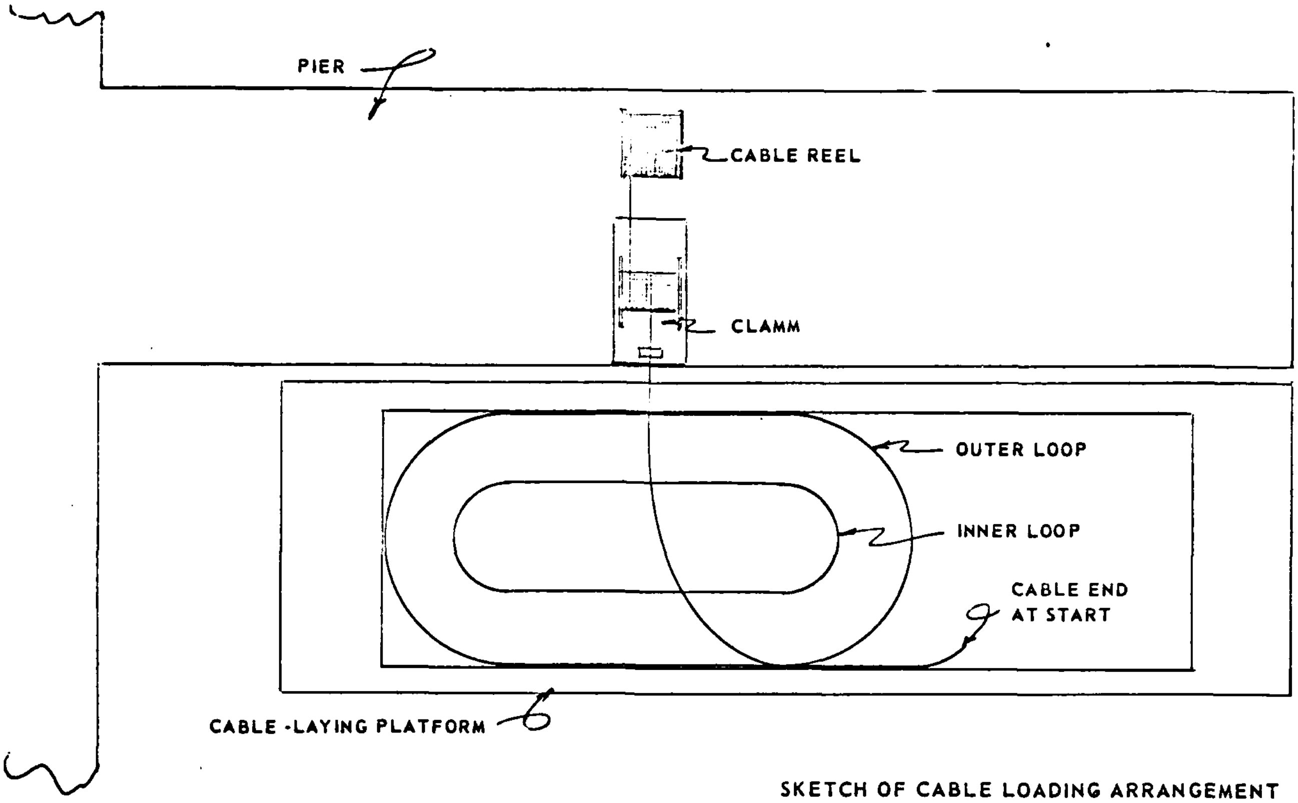
It is intended to separate the layers of cable loops with 12 inch widths of 1/2-inch plywood, each 8-feet long, and spaced about every ten feet between the layers of cable loops. This calls for some 240 strips of plywood cut from sixty four-by-eight foot sheets.

3.3 CABLE SPLICING, CHECKOUT, AND LOADING ABOARD THE PLATFORM

For the cable loading operation, the CLAMM will most likely be utilized to unreel the cable from the individual reels and to feed it aboard the YC-1092 where it will be manhandled into the prescribed stowage configuration. The CLAMM will be positioned at the side of a selected pier at the U. S. Coast Guard Base, Astoria, Oregon with the cable-laying platform positioned alongside so that the center of the cable bay is in line with the level wind fairlead of the CLAMM.

The decking of the selected pier is about 15 feet above the mean waterline anticipated during the cable loading period. The top of the CLAMM reel core, and the bottom roller of the level wind fairlead, will be about 7 feet above the pier deck and thus about 13 feet above the deck of the YC-1092 when loading commences. The cross-deck cable-stayed steel frame will be removed during the cable-loading operations and therefore the CLAMM can be controlled to feed the cable down to the deck where it can be hand fed into place in the cable bay. This general loading arrangement is sketched in Figure 9.

It is planned to load first the cable for Destruction Island and Smith Island. This totals some 80,000 feet of surplus communications cable carried on 27 reels. The procedure will be to load each layer in the cable bin starting with the outside loop and working inward toward the center loop. The first loop will start with a 10-foot length of cable leading aft outside the



SKETCH OF CABLE LOADING ARRANGEMENT

FIGURE 9

loop so that the end will be free for the electrical checkout procedures required as the stowage progresses.

These electrical tests will be conducted by telephone technicians from the 13th Coast Guard District using fault locating equipment and Meggers. Each test will comprise checking across the free ends of the cable for electrical continuity and Megger readings will be taken to determine insulation resistance. Accurate records of all tests shall be kept with sufficient identification data to locate along the cable the quality of the cable and the splices. As a minimum, checks shall be made at the following steps in the loading process:

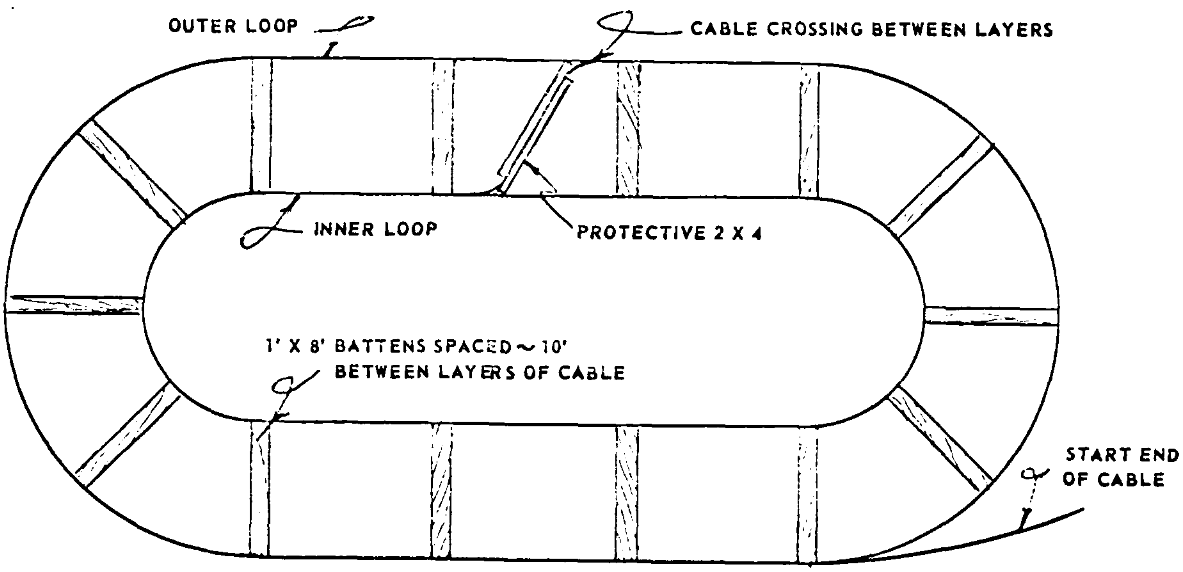
- o Each reel of cable shall be checked prior to splicing and prior to unreeling.
- o After each splice is made the entire length of previously spliced cable shall be checked before unreeling the last reel.
- o After unreeling each reel and stowing aboard prior to making the next splice.

Any reel that does not satisfactorily meet the first test above shall not be spliced in but be set aside for use only if insufficient intact cable is available to make up the 80,000 feet. If patching in of non-intact cables is

necessary, the defects shall be located, cut out, and the cable respliced and tested. It is suggested that a splicing hut be set up on the pier so that these operations can be performed out of the weather.

Starting with the first reel of communications cable, the first layer will be put down starting with the outer loop and working inward. As the end of the first reel is reached, the prescribed electrical checks will be made, the next reel spliced on the end, electrically checked again, and the laying continued. These checks will be repeated as each reel is spliced in and stowed.

Approximately two reels will be required per layer of communications cable in the cable bin. When the inside (48th) loop of the first layer is in place, the cable will be run radially outward over the top of the first layer to start the first loop of the second layer around the outer edge of the cable bin. As shown in Figure 10, this crossover section of cable shall be protected from the weight of succeeding layers by fitting 2 x 4 inch lumber on either side of the crossover. In addition, the 1 x 8 foot sheets of 1/2 inch plywood shall be laid down about every 10 feet over the layer before the next layer is started.



SKETCH OF CABLE CROSSING BETWEEN LAYERS

FIGURE 10

This process will be continued until the 13 1/2 layers of communications cable have been loaded aboard. The locations of the cable crossovers and the plywood battens shall be staggered between the various layers to keep the level of each layer as even as possible. After the first 13 layers of the surplus communications cable have been stowed, the fourteenth layer will be laid out with double spacing between loops so that the bitter end is accessible in the space within the inner loop. This will provide access for electrical checks and a means of determining the cable separation between the Cape Flattery and Destruction Island cable elements.

The loading of the ITT power cable will proceed in the same manner described above except that the cable will be supplied initially on three reels and only two splices will be required if there is no electrical discontinuity. As shown in Figure 9, the ITT power cable stowage will start with an open end running along the inside of the port bulwark to provide access for electrical checks. The 7 1/2 layers of this cable will be stowed in the same manner as the communications cable with the same type of crossover protection and the same batten protection between layers.

3.4 SCHEDULING OF OUTFITTING AND LOADING OPERATIONS

During the 40 days between arrival of the YC-1092 at the U. S. Coast Guard Station, and its departure for cable-laying operations at Neah Bay, Washington, the cable-laying equipment will be fabricated and installed and the cable will be spliced and loaded aboard. This work will be performed in general accordance with the schedule given in Figure 11. This schedule provides additional detail to the general schedule for the entire operation given earlier in Figure 6.

As in that previous schedule, the day T denotes the departure from Astoria for Neah Bay; this is expected to be 24 September 1976 if there are no delays due to shipments of equipment or unanticipated cable failures. In preparing for the cable-laying operations there are numerous requirements imposed upon CHESNAVFACENGCOM, 13th Coast Guard District, and UCT-2 personnel both to furnish equipment and to participate in the activities of the operation. These have been generally covered in the text of this project execution plan but are supplemented in the Miscellaneous Equipment and Requirements List of Appendix G.

SCHEDULE OF OPERATIONS AT U. S. COAST GUARD STATION, ASTORIA

FIGURE 11

OPERATION	T-40	T-39	T-35	T-32	T-30	T-28	T-21	T-17	T-8	T-7	T-3	T-2
YC-1092 ARRIVES ASTORIA, OREGON	▲											
INSPECTION, CLEANING EQUIPMENT FABRICATION		←	→									
TWO UCT-2 MEN ARRIVE TO ASSIST				▲								
CONSTRUCTION OF CABLE BIN IN YC-1092				←	—	→						
SPLICING EQUIPMENT SHIPPED BY HEXCEL, INC.					▲							
ITT POWER CABLE SHIPPED FROM SAN DIEGO						▲						
BARGE MOORED TO RECEIVE CABLE							▲					
LOADING & SPLICING OF COMMUNICATIONS CABLE								←	→			
LOADING & SPLICING OF ITT POWER CABLE										←	→	
FINAL OUTFITTING OF YC-1092											←	→

4.0 TRIAL RUNS AND TOWING OPERATIONS

4.1 DISPLACEMENT AND TRIM OF THE CABLE-LAYING PLATFORM

The YC-1092 has a nominal carrying capacity of 500 tons and a light ship weight of 145 tons for a total loaded displacement of 645 long tons. As can be seen from the displacement curve of Figure 12 this gives a light ship draft in salt water of 1.83 feet and a loaded draft of 7.22 feet. When the YC-1092 was inspected in Seattle prior to acquiring it for this operation it had a draft of 2.00 feet, even keel, salt water. This indicates a displacement of 159 tons; although this is greater than the reported light ship weight, and may be due to some water in the tanks, this value will be used as a basis for the modifications and cargo to be added for the LAMP project.

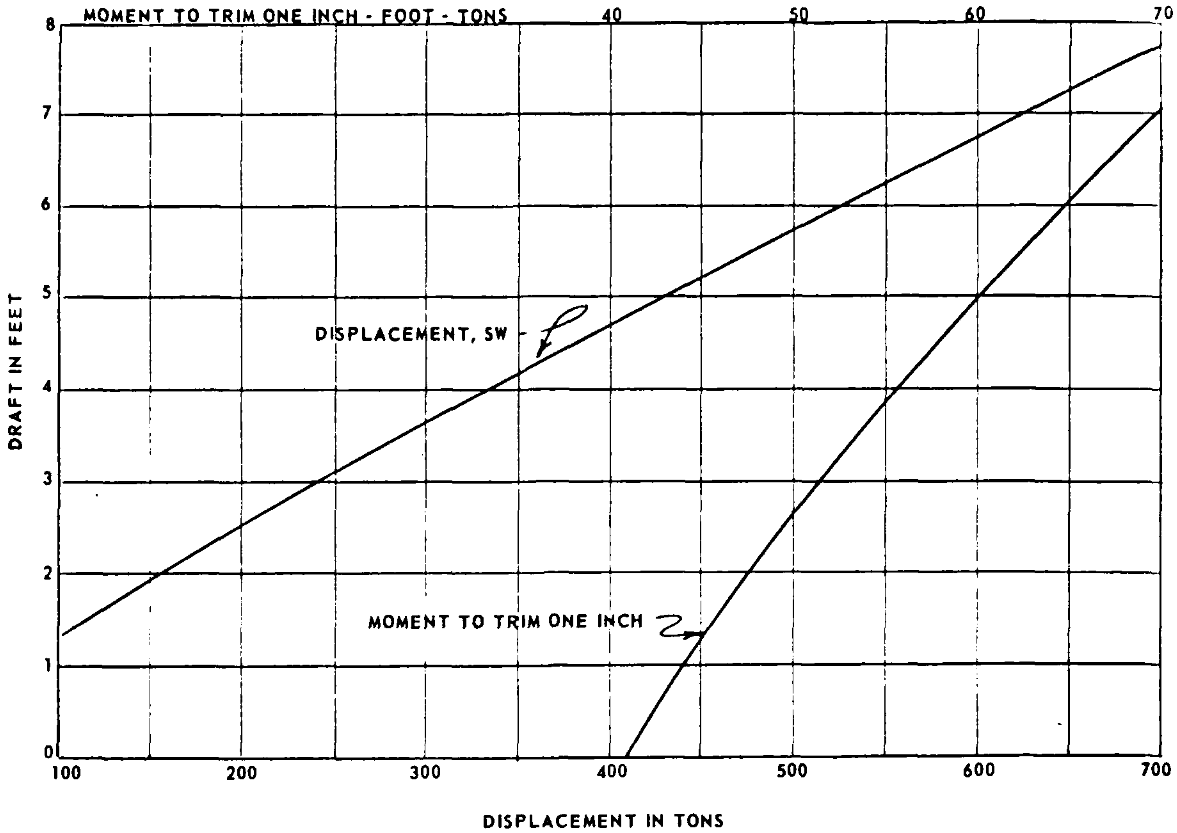
The weights to be added to the barge and their longitudinal centers of gravity are tabulated below along with the maximum deck loading that they may incur when placed aboard the YC-1092; these latter values are cumulative for those elements that are co-located.

	WEIGHT#	LCG FROM ⊗ FEET	LOAD IN #/FT^2
ITT CABLE 44,000 FEET	88,000	+ 15.00	
COMMUNICATIONS CABLE, 80,000 FEET	232,000	+ 15.00	
PROTECTION & SHORING LUMBER	2,000	+ 15.00	221.2
CABLE TRANSPORTER (CLAMM)	9,000	− 26.00	70.3
CABLE FAIRLEAD STRUCTURE	2,000	+ 15.00	400.0
SPLIT PIPE FOR CABLE PROTECTION	15,000	− 36.00	
MISCELLANEOUS GEAR & ANCHORS	12,000	−36.00	210.9
TOTALS	360,000#	@ 10.15 FT FWD.	
OR	160.71 TONS	@ 10.15 FT FWD.	
LIGHT SHIP	159.00 TONS	@ 0 FT FWD.	
TOTAL	319.71 TONS	@ 5.10 FT FWD.	

From Figure 12, the mean draft at this displacement is 3.86 feet and the corresponding moment to trim one inch is 55.0 foot tons. The forward trimming moment is 1631 foot tons giving a trim of 29.66 inches or 2.47 feet. This gives a draft forward of 5.10 feet and a draft aft of 2.62 feet. This is the load waterline shown on Figures 7, 8, and 13. Due to the trim by the bow created by this loading arrangement, it will be most efficient to tow the platform astern during transit between Astoria and Neah Bay; this will improve the dynamic stability of route of the towed system.

The deck loading capacity of the YC-1092 can be assumed to have a minimum value of its 500 tons cargo carrying capacity distributed over the 2464 square feet within the bulwarks. This gives a loading capacity of 455 pounds per square foot. Designs of this type are usually capable of supporting at least 500 pounds per square foot and therefore the maximum load concentration listed in the table above is within acceptable limits. The freeboard varies from seven to nine feet during these operations and therefore ladders should be provided for boarding.

The loading condition and the corresponding displacement, draft, and trim upon departing Astoria can be designated as Condition 1. The displacement and trim of the cable-laying platform will change during the operation as the cable and consumable equipment is off-loaded. Assuming total usage of the materials



DISPLACEMENT AND OTHER CURVES FOR YC-1092

FIGURE 12

allocated to each site the following conditions will obtain:

Condition 2, after Cape Flattery Installation:

Displacement 276.18 tons,	Draft, forward	4.31'
	Draft, aft	2.45'
	Draft, mean	3.38'

Condition 3, after Destruction Island Installation:

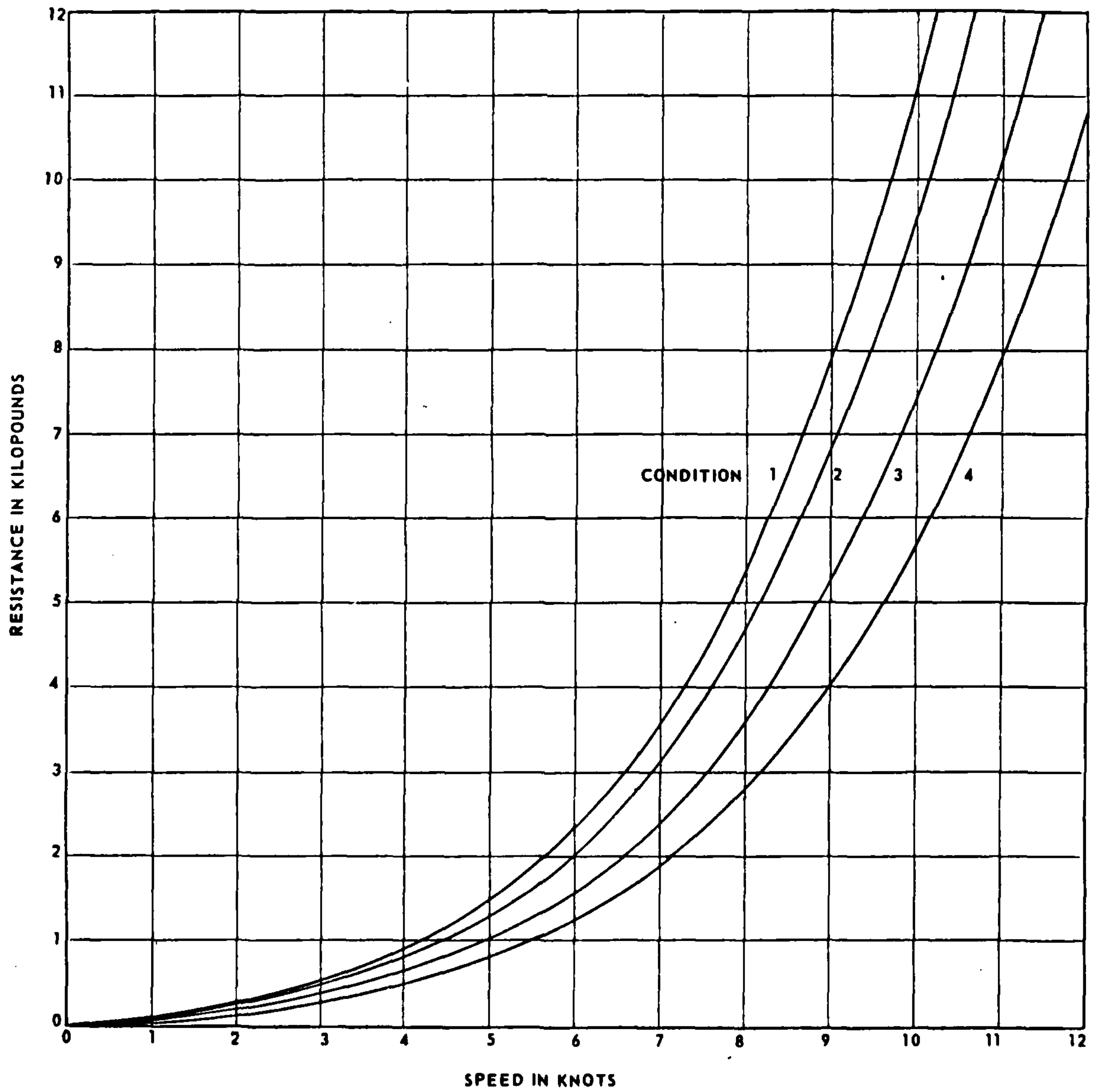
Displacement 215.96 tons,	Draft, forward	3.10'
	Draft, aft	2.30'
	Draft, mean	2.70'

Condition 4, after Smith Island Installation:

Displacement 164.13 tons,	Draft, forward	1.92'
	Draft, aft	2.22'
	Draft, mean	2.07'

Although towing by the stern is recommended from Astoria to Neah Bay it may be noted that the trim gradually changes as cable and gear are off-loaded.

When the YC-1092 completes the Smith Island operation it will be trimmed by the stern and conventional ahead towing can be used. A trim by the stern is desirable to provide dynamic stability of route in towing but the actual resistance, or towrope pull, required will be roughly the same for either ahead or astern towing. Thus the resistance curves given in Figure 13 for the YC-1092 are applicable to either the transit mode or the cable-laying mode for each of the four loading conditions cited above.



RESISTANCE OF THE YC-1092 IN VARIOUS LOADING CONDITIONS

FIGURE 13

4.2 TRIAL RUNS IN THE COLUMBIA RIVER

One day prior to the departure for Neah Bay (T-1) to install the first of the three cables, a shake down period will be devoted to training personnel and testing cable-laying techniques and equipment. These trials will be conducted in the Columbia River off the U. S. Coast Guard Base, Astoria, Oregon.

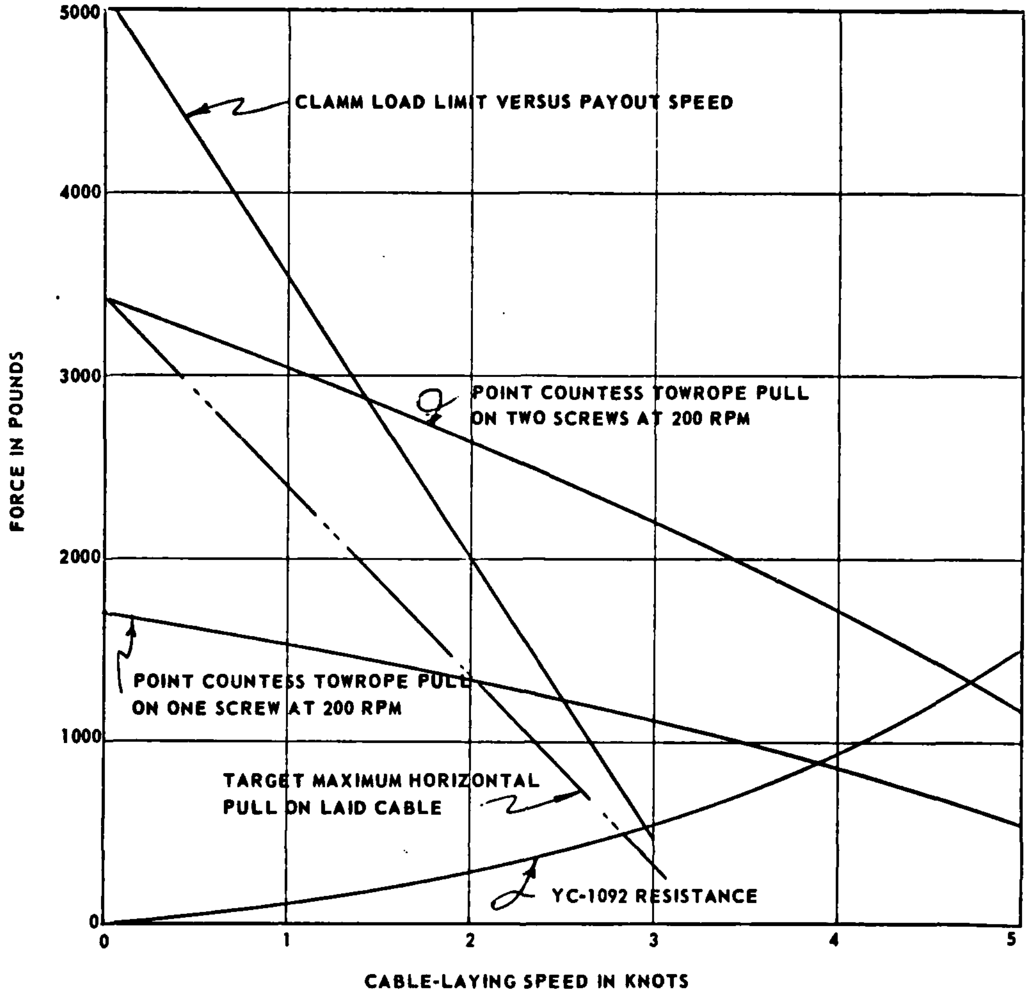
The principal purposes of these trials are fourfold:

- Training and familiarization of all personnel involved (CHESNAVFACENGCOM, UCT-2, *POINT COUNTESS*, and 13th CGD) with the equipment and installation techniques.
- Determination of the most desirable cable-laying speed as related to the system elements being utilized.
- Determination of how the CLAMM, cable brake, chute, and fairleads will be utilized and controlled in the operation.
- Adjustment and revision of equipment, laying techniques, and communications arrangements as necessary to ensure smooth operations.

The second of the above purposes, that of determining laying speed, and how to control it is the most critical. The problem can best be explained by reference to Figure 14 which shows the forces involved as they apply to various elements of the towing system.

The *POINT COUNTESS* is propelled by a pair of 800 hp diesel engines geared to its two propeller shafts. When these engines are throttled down to idling speed the propellers are still turning fast enough to propel it at a speed of about four knots. To reduce the ahead thrust to zero the propeller shafts must be declutched from the engines. The lowest speed that the propellers should be turned in towing operations is on the order of 200 RPM. At this RPM the *POINT COUNTESS*, operating on both screws, would tow the YC-1092 at a speed of 4.75 knots; on one screw at 200 RPM the towing speed would be about 4.0 knots, still much too fast for cable-laying.

The cable-laying speed can be considerably reduced by pulling against the cable to whatever degree is necessary to lay it along the prescribed course. There are two limits on the load that can be applied: one is the load limitation on the CLAMM which, as shown in Figure 14, is a function of the speed at which the cable is payed out. The other is the strength of the cable itself;



FORCES INVOLVED IN CABLE-LAYING OPERATIONS

FIGURE 14

this is limited primarily by the cable splice strength for which a value of 5,000 pounds should probably be a maximum. Since this is the upper limit of the CLAMM holding capacity it is suggested that the target horizontal pull of the cable be limited to two-thirds of the CLAMM capacity as shown in Figure 14.

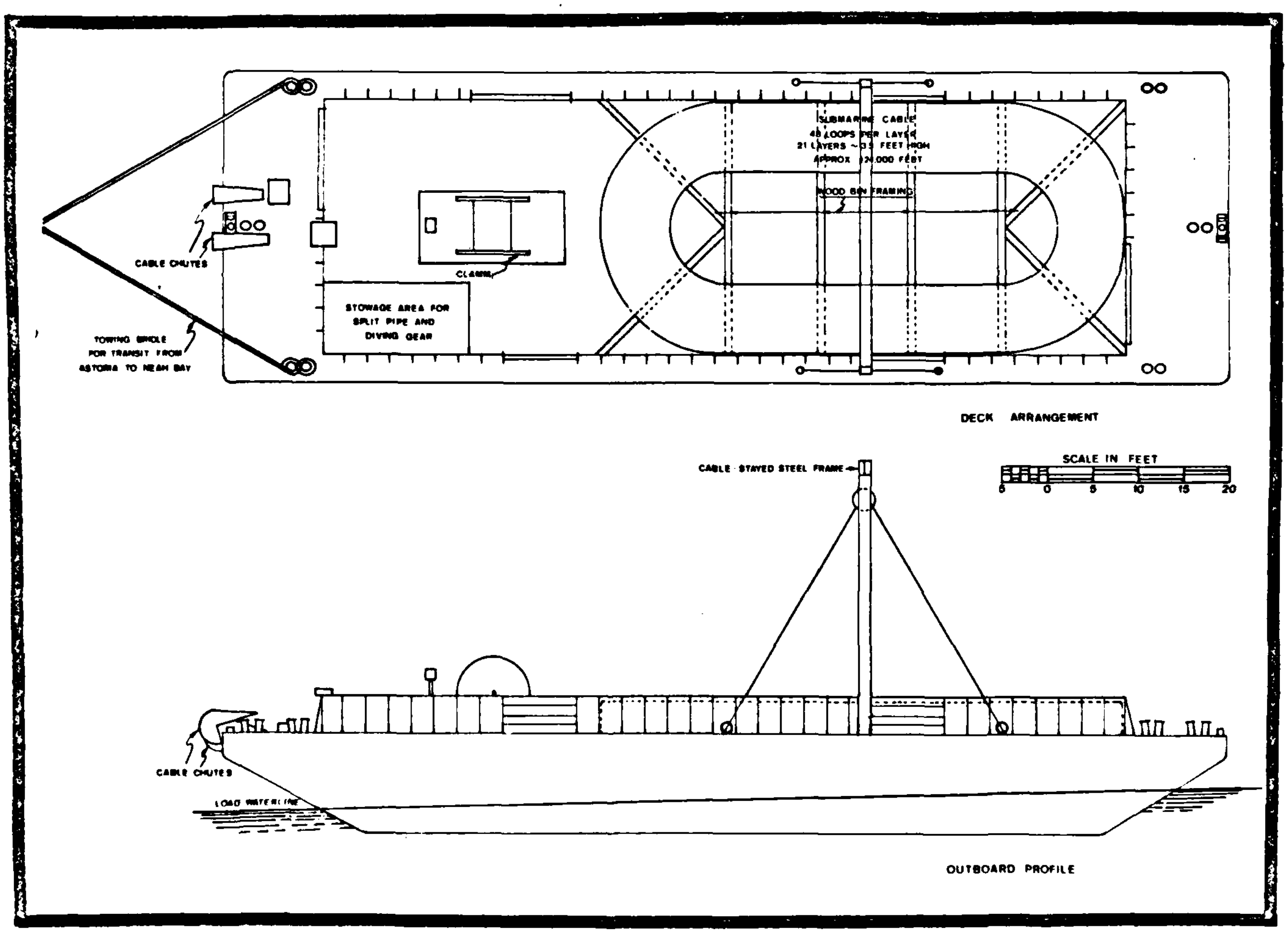
If this balance of forces is acceptable, it appears from the data available that a cable-laying speed on the order of 1.5 knots would be acceptable. At this speed the towrope pull on one screw at 200 RPM would be about 1,450 pounds and the barge resistance 160 pounds leaving 1,290 pounds horizontal pull on the cable which is within the capacity of the CLAMM for cable angles with the horizontal up to and exceeding 60°.

The trials in the Columbia River should attempt to establish speeds, propeller RPM, tensions, and acceptable cable angles for those laying conditions as well as performing the personnel training and equipment assessment functions listed previously.

4.3 TOWING FROM ASTORIA TO NEAH BAY

Towed alongside the [illegible] instead of behind

The *POINT COUNTESS* will take the YC-1092 in tow from the U. S. Coast Guard Station at Astoria, Oregon. The cable-laying platform will be towed stern-first, using the bridle arrangement shown in Figure 15. According to calculations based upon towing data furnished by the Coast Guard there should be no problem in making the trip at a speed of 10 knots which would require a total of no more than 16 hours to reach U. S. Coast Guard Station at Neah Bay, Washington.



YC-1092 ARRANGED FOR TOW TO NEAH BAY

FIGURE 15

Sea state and weather conditions will dictate the method of towing the barge during both transit and cable-laying maneuvers. Mooring and handling line (nylon) for towing, alongside mooring, and 4-point mooring in water depths to 100' are required. Six 60 lb. anchors (2 each mushroom, Danforth, and grapnel), and sixteen 250 pound concrete clump anchors are required for bottom moors in varied bottom conditions. Assisting vessels for the Navy Seabees can provide other lengths of lines, shackles, and other supplies required.

4.4 NAVIGATION EQUIPMENT AND PROCEDURES USED IN CABLE-LAYING

The following navigation equipment will be used for cable-laying operations:

- Motorola Mini-Ranger console with 3 transponders, 3 tripods for the transponders, 24-volt batteries to supply direct current to the console and transponders, and electrical cables for all units.
- Three transits, with tripods
- Portable depth recording system
- Miscellaneous navigation tools and supplies
- Navigation charts
- Eight 12-volt batteries, with 2 battery chargers

This equipment will be shipped directly to the Coast Guard Station at Neah Bay and put aboard the appropriate vessels at that point.

Navigation central for cable-laying operations will be established on the *POINT COUNTESS*. It will include the Mini-Ranger console (receiver and readout) and the depth recording system. Depth recordings will be made of all three cable routes, including the near shore portions. If feasible, the portable depth recording system will be used in a small boat to record bottom conditions of the near shore area during cable transfers while the barge is moored. The navigator aboard the *POINT COUNTESS* will receive input from the shore-based

stations and from the *POINT COUNTESS* bridge, and maintain a continuous plot of barge location and over-the-bottom distance travelled.

The location and zero reference angle of all navigation shore stations for use of both the Mini-Ranger transponders and the surveyor's transits will be determined prior to the day of cable installation, and verified again just before cable laying. The Mini-Ranger console and transponders, and the transits will be transported to each site, if necessary, prior to installation to obtain this information. The information will be used as a navigation input during cable laying and as a record of the location of the installed cables, location of splices, etc.

Two "Navigation Format" sheets will be utilized during the installation. Navigation Format #1, Figure 16, will be used to record: the precise location at each site of the Mini-Ranger transponders and the surveyor's transit as well as the zero angle reference used with the surveyor's transit at each site. Note that the location and angle reference data will, in most cases, be "relative" information based on the range or distance to a known charted location. In certain instances the location or angle reference will coincide with actual charted landmarks or true (or magnetic) bearing angles. If charted reference landmarks are not available, a detail description of the landmark, and the methods used in locating the site relative to the landmark, shall be recorded.

Navigation Format #2, Figure 17, provides for recording data obtained during the operation. The data, lighthouse reference, and time of day must be recorded on all sheets. In addition to other reference uses, the time of day for each reading is the basic reference for coordinating this information with other project data, including the depth sounding chart recording. Mini-Ranger station readings register in meters; upon request these must be converted to feet of cable laid along the route. This will appear in the remarks column noting actual distance in feet travelled on the route, including dog-legs, and not necessarily the distance in feet from a particular station. Transit angle readings will be utilized to keep the barge on a straight heading or course and/or for navigation in the event of a Mini-Ranger system failure.

NAVIGATION FORMAT #1

FIGURE 16

LIGHTHOUSE ______________ DATE ____

FROM ______________ TO ______________

FOR USE IN DETERMINING AND RECORDING:

- THE PRECISE LOCATION AT EACH SITE OF THE MINI-RANGER TRANSPONDERS AND THE SURVEYOR'S TRANSITS, AND
- THE ZERO ANGLE REFERENCE USED WITH EACH OF THE SURVEYOR'S TRANSITS
- THE LOCATION AND ANGLE REFERENCE DATA WILL, IN MOST CASES, BE "RELATIVE" TO A KNOWN (CHARTED) LOCATION. IN CERTAIN INSTANCES THE LOCATION OR ANGLE REFERENCE WILL COINCIDE WITH ACTUAL CHARTED LANDMARKS OR TRUE OR MAGNETIC BEARING ANGLES. IF CHARTED REFERENCE LANDMARKS ARE NOT AVAILABLE, A DETAILED DESCRIPTION OF THE LANDMARK, AND METHODS USED IN LOCATING THE SITE RELATIVE TO THE LANDMARK, SHALL BE RECORDED.

SITE NO. ________ SITE NAME OR DESCRIPTION ______________________________

MINI-RANGER TRANSPONDER CHANNEL (CODE) ______________________________

TRANSIT ZERO ANGLE REFERENCE ______________________________

SITE LOCATION DETERMINATIONS: ______________________________

____

____

____

____

____

____

NAVIGATION FORMAT #2

FIGURE 17

LIGHTHOUSE ______________ DATE ____

FROM ______________ TO ______________

TIME OF DAY	MINI-RANGER STATION READINGS RANGE IN METERS				TRANSIT ANGLE READINGS			DEPTH IN FEET	REMARKS (INCLUDE DISTANCE TRAVELLED IN FEET)
	SITE 1 CHAN ___	SITE 2 CHAN ___	SITE 3 CHAN ___	SITE 4 CHAN ___	SITE 1	SITE 2	SITE 3		

5.0 CAPE FLATTERY INSTALLATION

5.1 SITE DETAILS, CABLE ROUTE, AND NAVIGATIONAL AIDS

Smith Island done first

A section of the nautical chart detailing the Cape Flattery area is given in Figure 18.

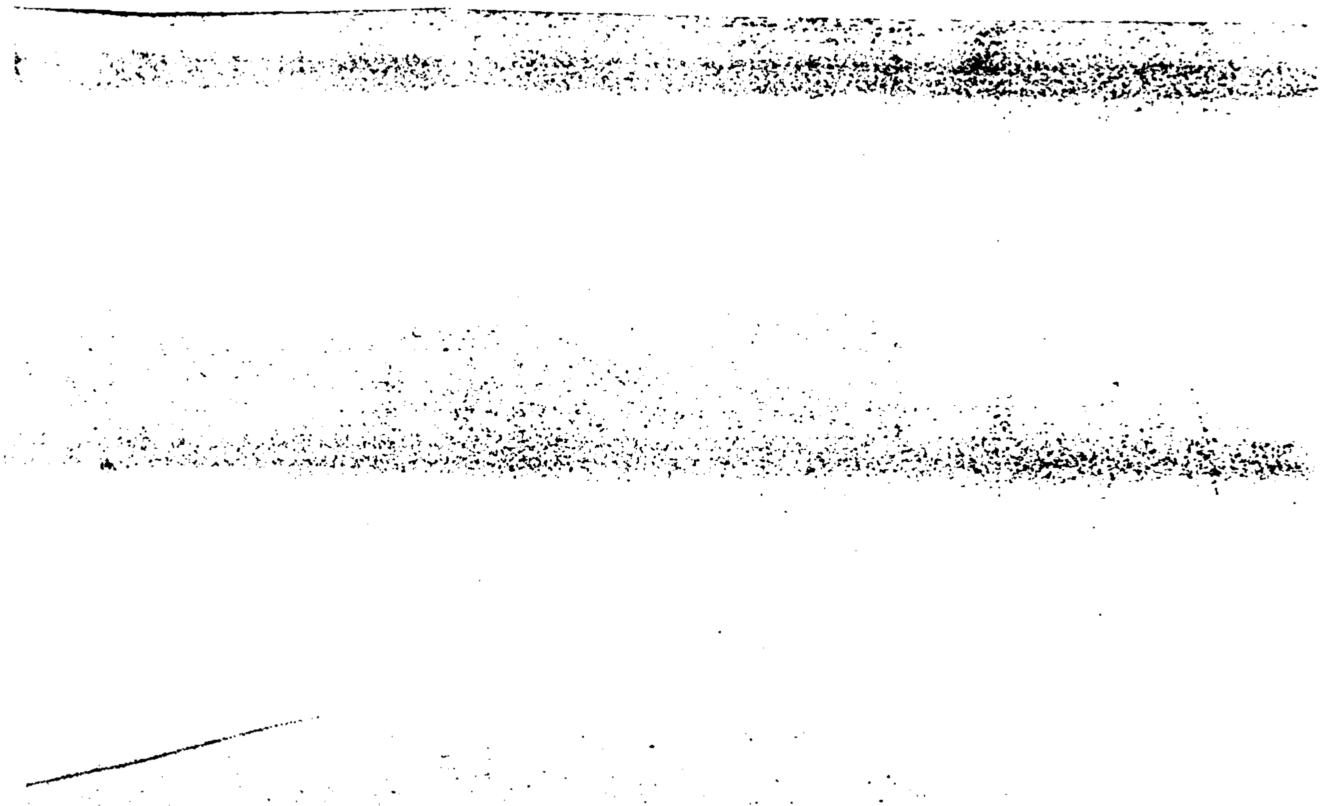


FIGURE 18

The existing cable route to Tatoosh Island appears to be satisfactory and will be utilized for the new power cable. A favorable approach to the lighthouse appears to be into the protected sandy cove on the north side of Tatoosh Island. The cable run to northwest Neah Bay (western end of breakwater to Waadah Island) is about 6NM. A commercial power source (pole) is located a few feet from the proposed cable landing beach site.

Navigational aids, consisting of a Mini-Ranger transponder and/or a surveyor's transit are to be set up in the following locations:

- The sand cove just north of Tatoosh Island;
- The beach landing at Neah Bay just north of the breakwater to Waadah Island;

- At the northernmost of the two lights on Waadah Island (just off the lower right side of Figure 18);
- On the breakwater leading to Waadah Island directly in line with the third leg of the cable run (Transit Station).

The chart of the cable run between Tatoosh Island and Neah Bay shows four legs (3 turns) on the route. On all but the second leg a transit can be utilized to "keep the barge on line" while the Mini-Ranger is recording the range.

UCT-2 Seabee divers reported bottom conditions approaching Tatoosh Island to be rocky, erratic, and partially hazardous to the cable:

- course sand out to 10' depth
- 10' to 35' depth, heavy kelp
- 20' depth, rocks 3' to 10' in diameter
- gradual rocks and sand slope to 45' depth
- at 38' depth rocks were 10' to 30' in diameter
- crevices started at 38' depth
- 45' depth, crevice 20' wide with sand bottom
- 48' depth, ledge 10'
- 55' depth, large crevice approximately 80' span about 35' to bottom
- 65' depth, 3' ledge
- 80' depth, vertical drop to about 100' depth
- Beyond 100' depth the bottom is more gradual and smooth (reaching 300' maximum) into Neah Bay. Bottom conditions are rock and sand.

More detailed location and description information for the shore sites is obtained in Appendixes B and E.

It may be noted that the depth along the cable route averages about 25 fathoms (150 feet) for the first leg and 42 fathoms (252 feet) for the second leg. The third leg shoals off from 40 fathoms (240 feet) to 5 fathoms (30 feet), and the fourth leg runs from the latter depth up to the beach. Catenary data for the ITT cable, i.e., force and lead-off angles as functions of depth, can be obtained from the tables and curves given in Appendix F.

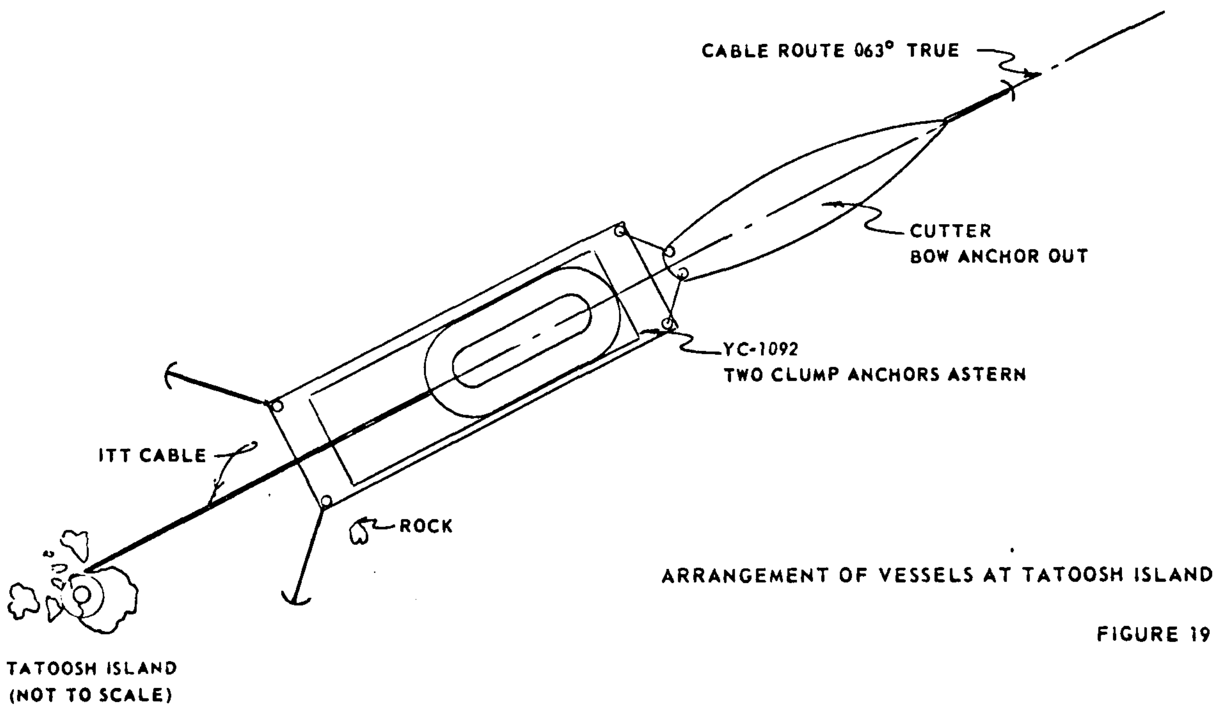
At the Neah Bay end of the cable route, UCT-2 divers have reported the following bottom conditions, working from the beach out to the east-northeast:

- 0-15' depth, rock bottom with sandy areas; very heavy kelp with 2' diameter round rocks;
- 15' to 30' depth, sand bottom with larger rocks; some small 2' rock ledges;
- 30' to 45' depth, about 4/5 sand bottom with 2' to 3' rock ledges (with sharp edges); rocks up to 10' diameter;
- 45' to 60' depth, smooth rock and sand, some rock boulders;
- 80' depth is approximately 1,000 yards off beach landing site along cable route;
- 12' depth at mean low water is about 300 yards from beach landing site.

5.2 LAYING CABLE FROM TATOOSH ISLAND TO NEAH BAY

With the YC-1092 prepared to lay cable, and in tow by Coast Guard Cutter *POINT COUNTESS*, proceed from the Coast Guard Station, Neah Bay to the designated sandy cove off Tatoosh Island (NE of Cape Flattery Lighthouse). At the cove, position the barge aft of the cutter (close in, barge/tug fashion with suitable fenders separating the two vessels).

Anchor the barge and cutter in accordance with the sketch, Figure 19, in line with the first leg of the cable route (063° True/040° Magnetic): the after end of the barge will be abeam of prominent rock protruding from the water about



ARRANGEMENT OF VESSELS AT TATOOSH ISLAND

FIGURE 19

300 yards from the cove, use 250 lb concrete clump anchors to hold the stern of the barge in this position. The cutter bow anchor will be used to maintain the *POINT COUNTESS* in the position shown as the end of the ITT cable is carried in to the beach.

Immediately prior to hauling the cable ashore, an electrical continuity check will be made on the entire length of ITT cable. The Tatoosh Island end of the two leads will then be tied together and a resistance value established for the power leads from the Neah Bay end of the cable; this resistance will be monitored throughout the operation.

Proceed to haul the cable out astern. Tie the inflated floats to the cable every 50 to 75 feet, or two per cable loop in the bin. (The average length of a cable loop will be 123 feet, with the inner loop 98' and the outer loop 148'). The cable will be handled out either by hand, with LARC or other boat assistance, with the CLAMM capstan, or with the CLAMM drum. The exact procedure will be determined as a result of cable and barge procedure trials and training. The LARC will haul the cable up on the beach and secure it to a natural or constructed "deadman". The Coast Guard will determine the length of excess cable desired on the beach.

Seabee divers, utilizing their ZODIAC inflatable craft as a dive boat, will proceed to cut, and retrieve, the cable floats commencing at the beach. These divers will attempt to guide and place the cable in the most suitable configuration on the bottom, between rocks, off ledges, into crevices, on sand, and in the most favorable lay to meet cable protection and stabilization requirements. This process will continue until the last float near the barge has been removed.

The *POINT COUNTESS* will retrieve its bow anchor and ease away from the barge to the extent of the towing bridle, ready to gradually pay out towing line and increase distance between cutter and barge while maintaining a slight tension in the towing line. The length of tow line during cable laying will depend upon wind and sea conditions. In the event of extremely calm wind and seas, the *POINT COUNTESS* may be utilized as an "alongside" tug and can tow and maneuver with the barge in that fashion. The LARC V and the Coast Guard 42' SAR boat will assist with maneuvering and positioning as required.

With the CLAMM ready to pay out cable, divers will cut the two mooring lines

to the concrete clumps at the after end of the barge; barge hands will retrieve lines. The CLAMM will then pay out cable as required to avoid excessive strain as the barge gets underway. If the decision is made to lay the cable using the brake alone, bypassing the CLAMM, the brake will be released to allow the cable to pull out of the bin as the barge advances.

The *POINT COUNTESS* will gradually build up to a speed that has been predetermined as a result of trials at Astoria and then maintain steady turns. During the trial procedures it will have been determined if the cutter can use both screws or only one screw, or must keep one screw in reverse to hold the speed down to the desired one to two knots. If the CLAMM is utilized, it is of greater importance to maintain steady speed and towrope pull by the *POINT COUNTESS* while adjusting cable tension with the CLAMM. Essentially the CLAMM will be the speed control device for the operation since the payout speed will be adjusted to maintain the cable tension within satisfactory limits. These tension limits will be preestablished in terms of lead-off angles of the cable from the chute for the various depths of water encountered in the cable-laying operations. The CLAMM payout speed will be adjusted to maintain the lead-off angle within the limits derived from the data in Appendix F.

Navigation along the cable route will be in accordance with the procedures outlined in Section 4.4. During the cable laying, the LARC V and the Coast Guard 42' SAR boat will accompany the cutter and barge for use as required in maintaining track and relative position. Upon approaching the Neah Bay cable landing site the barge will moor as indicated in Figure 20.

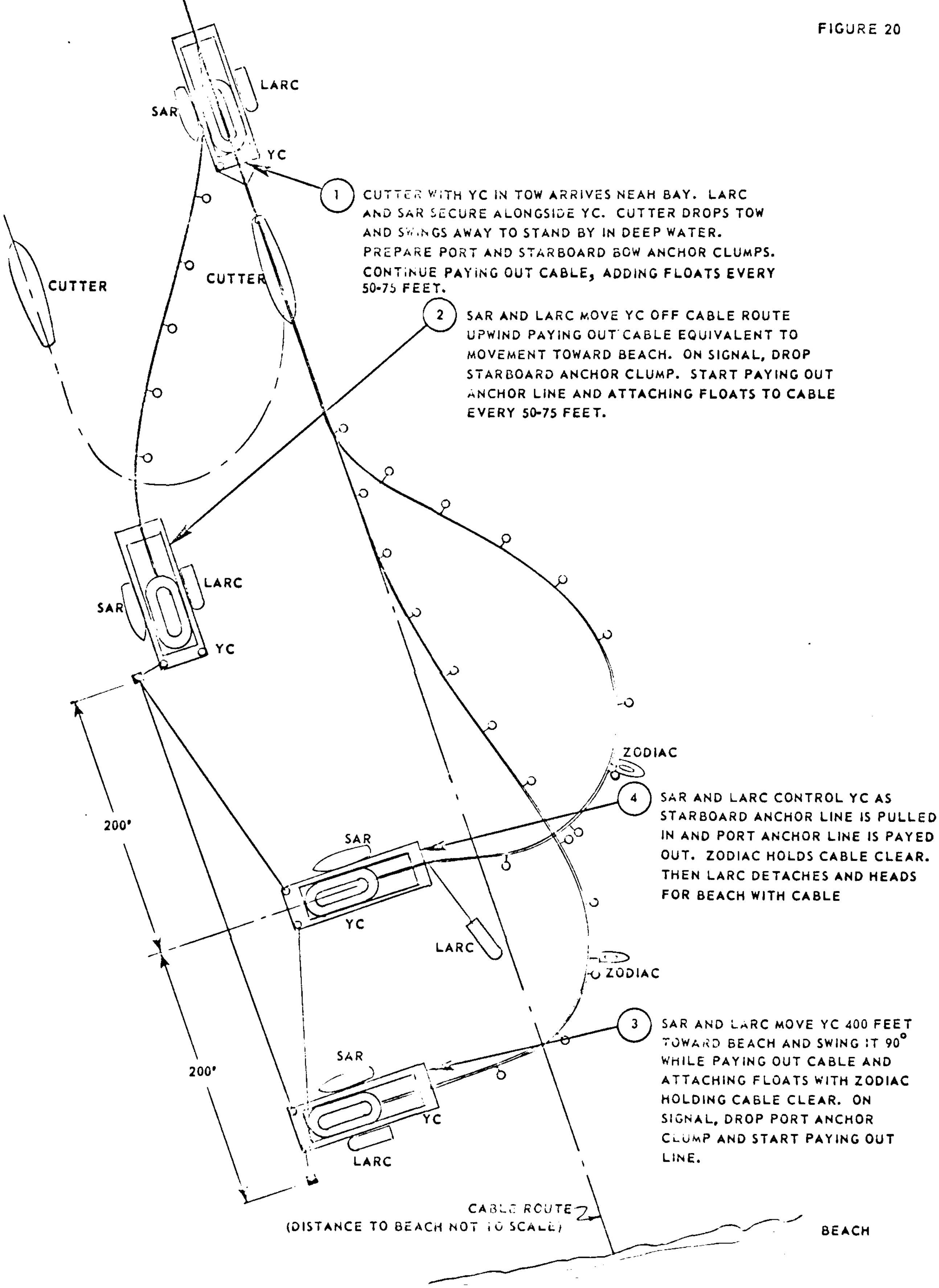
After the barge is moored as indicated, determine the footage of cable required to reach beach plus a sufficient margin to provide for the power line hook-up; make a final check of the electrical resistance of the entire length of ITT cable. Payout the cable applying floats every 50 to 75 feet. Cut and seal the cable end and attach a leader line for transfer to the beach.

A considerable length of cable will necessarily be floating near the barge during the payout period prior to transferring the cable to the beach. The LARC, ZODIAC, TICWAN, or the cutter WHALER will be utilized to control this cable loop and to effect a transfer onto the beach.

If the LARC cannot maneuver up on the beach due to rocks, debris, or bottom conditions, a Coast Guard truck on the beach or nearby road, will be utilized

PROGRESSIVE STEPS FOR MOORING THE YC-1092 IN NEAH BAY

FIGURE 20



to haul the cable ashore, and to hold a strain during the cable placement on the bottom. Divers will proceed to cut the cable float baloons off the cable from seaward on in to the beach. They shall then attempt to position the cable in the most favorable configuration on the bottom. Upon completion, the cable will be secured on beach to keep from sliding out to sea. After the cable has been secured on shore and final electrical measurements made to ensure continuity, the *POINT COUNTESS* will move in to take the YC-1092 in tow again. When the bridle and towline is hooked up, divers will cut the lines to the concrete anchor clumps, and the cutter and tow will proceed back to the Coast Guard Station, Neah Bay. There, the excess ITT power cable will be off-loaded and the vessels readied for the Destruction Island Operation.

5.3 CABLE PROTECTION, STABILIZATION AND INSPECTION

Based on the cable route survey data, the Tatoosh Island shore site will definitely require split-pipe protection with rock bolts into the bottom to stabilize the split pipe. The Neah Bay approach may require some protection and stabilization. At both ends, the cable will be trenched by land equipment on the beach and as far into the water (at low low water) as possible. Beyond the protection zone it is expected that the cable will bury itself in the sand or mud bottom as a result of cable weight and sea movement due to weather, tides, and currents.

Two hundred half sections of split pipe, plus hardware, will be carried aboard the YC-1092. The pipe will assemble into 100 full sections each 3' in length, providing 300' of protection.

Since the split pipe is designed for 3 1/2" cables, filler shim material in the form of fire hose is placed above and below the 1.15" cables to be used for this installation.

After the Cape Flattery installation UCT-2 Seabee divers will inspect the installed cable from the beach to 80' depth off Tatoosh Island. Split pipe sections shall be installed on the cable at locations potentially hazardous to the cable. Rock bolts shall be used to secure and stabilize the split pipe sections to the bottom. A record of the location, and details of the process will be maintained by UCT-2.

A similar inspection will be made at the Neah Bay end of the Cape Flattery installation; cable protection and stabilization shall be installed there if required.

5.4 SCHEDULE FOR CAPE FLATTERY OPERATIONS

It is anticipated that the complete operation for the Cape Flattery Lighthouse cable installation, stabilization and protection can be completed within six days after the arrival of the *POINT COUNTESS* with the YC-1092 in tow at Neah Bay. The detailed schedule for this period is given in Figure 21 with that for the Destruction Island operations to follow:

SCHEDULE OF OPERATIONS OUT OF NEAH BAY

FIGURE 21

OPERATION	T+1	T+2	T+3	T+4	T+5	T+6	T+7	T+8	T+9	T+10	T+11
CUTTER WITH YC IN TOW ARRIVES AT NEAH BAY	▲										
CHECKOUT AND PREPARATION FOR CAPE FLATTERY INSTALLATION		←	→								
LAY CABLE - TATOOSH ISLAND TO NEAH BAY				▲							
OFFLOAD SURPLUS ITT CABLE AT NEAH BAY					▲						
PROTECTION AND STABILIZATION OF CABLE AT TATOOSH ISLAND					←	→					
PROTECTION AND STABILIZATION OF CABLE AT NEAH BAY							▲				
DEPARTURE FOR INSTALLATION AT DESTRUCTION ISLAND							▲				
INSTALLATION OF CABLE FROM DESTRUCTION ISLAND TO COAST								▲			
PROTECTION AND STABILIZATION OF CABLE AT DESTRUCTION ISLAND									←	→	
PREPARATION FOR DEPARTURE FROM NEAH BAY									←	→	
DEPART NEAH BAY FOR PORT ANGELES											▲

6.0 DESTRUCTION ISLAND INSTALLATION

6.1 SITE DETAILS, CABLE ROUTE, AND NAVIGATION AIDS

The Destruction Island cable route will be a straight run from the southwest side of the island to the mainland as shown in Figure 22.

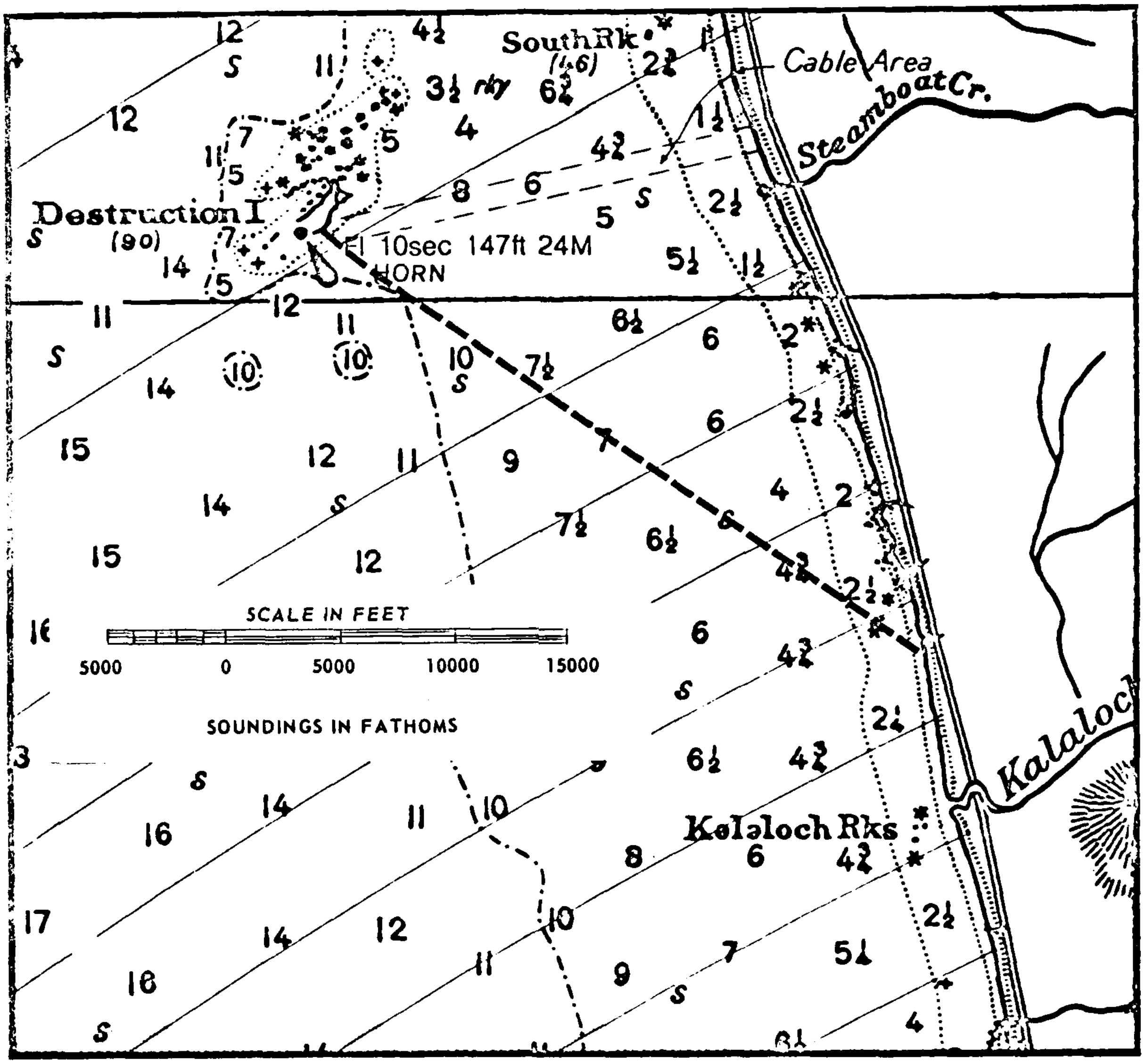


CHART OF DESTRUCTION ISLAND CABLE ROUTE

FIGURE 22

The survey report for this route is as follows:

o Mainland Beach Site - Shore approach is a gradual sand bottom with no rocks and little vegetation. The beach site is opposite the state highway maintenance station one mile north of Kalalock, Washington on U. S. Highway 101.

- o Destruction Island - Two adjacent coves on the southeast shore of island were surveyed as the only acceptable approaches although both present very hazardous underwater conditions for the cable. The western cove presented a slightly more favorable beach landing. Both approaches contained some sand bottom but more rock to the 15' depth. Heavy vegetation was present. From about 15' to 70' depth, solid rock was encountered. Crevices were cut into the rock parallel to the beach, with vertical walls as deep as 30'. At approximately 350 yards distance from the coves (70' depth) the bottom turns sandy. This condition is maintained all the way to the mainland beach site. The depth gradually decreases, averaging 50 feet into the shore.

Navigation stations will be established at both the Destruction Island and the mainland ends of the cable route including both Mini-Ranger transponders and surveyor's transits. Consideration will also be given to setting up a surveyor's transit site on the mainland due east of Destruction Island to obtain more accurate positioning data in the event of Mini-Ranger failure.

6.2 DESTRUCTION ISLAND CABLE-LAYING OPERATIONS

Staging for the cable installation to Destruction Island (as with Cape Flattery) will be at the Neah Bay Coast Guard Station; there is no closer facility that will accommodate the draft of the cutter or barge. With each of the three cable installations an attempt will be made to be moored at the starting site just after first light in the morning to accomplish the installation plus both shore end transfers on the same day. For the Destruction Island installation the cutter and barge must transit to the site area the previous evening to reach the island by dawn.

For the Cape Flattery installation, prevailing weather and sea conditions at Tatoosh Island will most probably dictate an installation starting under favorable conditions at Tatoosh Island proceeding to the calmer area around Neah Bay. However, for Destruction Island the surf and breakers along the mainland beach must be considered as well as the conditions at the Island. Another factor controlling this decision (to be made on-site) is the requirement to haul about 1,000 yards of cable onto the mainland beach from the barge since the barge will be moored a considerable distance from the beach (outside the breakers). Also, additional hook-up cable will be needed at this site to avoid making a splice on a public beach.

The procedure for mooring, barge handling, cable-laying, hauling the cable ashore, and the selective placement of cable on the bottom by divers (required only at Destruction Island end for this route) will be similar to the Cape Flattery installation. Figures 19 and 20 are generally applicable to the Destruction Island installation and these procedures can be tailored to the latter site.

Electrical checks should be made for continuity and resistance of the cable just prior to and just after completion of the laying operation. Since the surplus communications cable will be used for this operation the catenary, the forces, and the lead-off angles will be different than those applicable to the ITT cable. Similarly the lesser depths alter the catenary equations to a considerable extent. Data specifically related to the catenary configuration of the cable-laying at Destruction Island are given in Appendix F.

6.3 CABLE PROTECTION, STABILIZATION, AND INSPECTION

Based on the cable route survey data, the Destruction Island end of the cable will definitely require split-pipe protection with rock bolt stabilization. On both ends, the cable will be trenched (by land equipment) on the beach and as far into the water (at low low water) as possible.

Since the split pipe is designed for 3 1/2 " cables, filler shim material in the form of fire hose is placed above and below the 1.56" cable to be used for this installation.

After the Destruction Island installations, UCT-2 Seabee divers will inspect the installed cable from the beach to the 70' depth off Destruction Island. Split pipe sections shall be installed on the cable at locations potentially hazardous to the cable. Rock bolts shall be used to secure and stabilize the split pipe sections to the bottom. A record of the location, and details of the process will be maintained by UCT-2.

6.4 SCHEDULE FOR DESTRUCTION ISLAND OPERATIONS

The schedule for operations at Destruction Island is included with those for Cape Flattery in Figure 21. At the conclusion of the cable-laying, the *POINT COUNTESS* will tow the barge back to Neah Bay to wait for the completion of the cable protection and stabilization operations and to prepare for the transit to Port Angeles for the Smith Island installation.

7.0 SMITH ISLAND INSTALLATION

7.1 SITE DETAILS, CABLE ROUTE, AND NAVIGATION AIDS

The Smith Island cable route ~~will~~ be a straight run from Smith Island almost due east to Whidbey Island as shown in Figure 23.

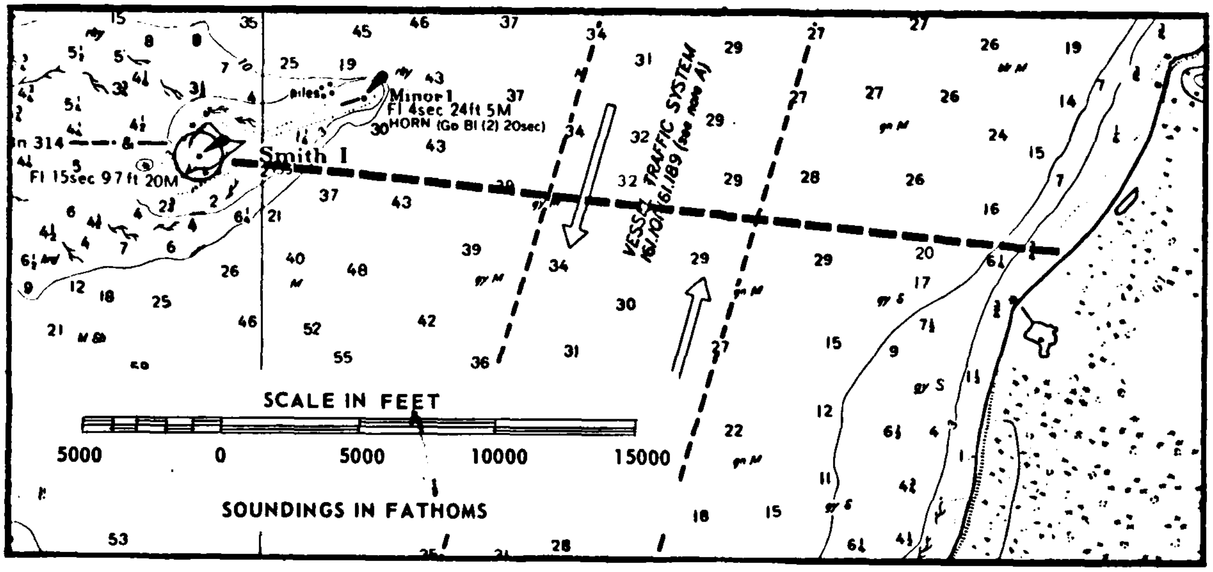


CHART OF SMITH ISLAND CABLE ROUTE

FIGURE 23

The survey report for this route is as follows:

- o Whidbey Island Beach Site - An all sand bottom exists from mean low water on the beach to a 60 foot depth about 1,000 yards off the beach, with only small scattered rocks visible. A 50' strip of small loose rocks (up to 6" diameter) runs along the beach from the mean low water line up the beach, changing gradually to all sand. The Whidbey Island site is at the southeastern tip of the original Ault Field/Naval Air Station property. Appendixes A and B identify and locate the property more accurately. The beach is strewn with some rocks, debris, and a considerable number of logs of all sizes (some 3' in diameter and 60' long). Similar debris is found on all six beach landings for these three cable installations.
- o Deep Water - Soundings indicate a gradual smooth bottom as deep as 250' on the run between Whidbey Island and Smith Island with sand and mud prevailing.

- Smith Island - About 350 yards southwest from the start of the land bridge (during low water) to Minor Island, a slight cove is formed covered with smooth, loose rocks considerably smaller in size than those in the surrounding area. This site is almost on a direct line from Smith Island Lighthouse to the beach site at Whidbey Island. The rocks on the beach form a 50' wide path turning to sand higher up the beach. The underwater route is hard-packed sand gradually sloping to 30' depth then sloping steeper to 60', approximately 1,500 yards off the beach.

Navigation stations will be established at both the Smith Island and the Whidbey Island ends of the cable route including both Mini-Ranger transponders and surveyor's transits.

7.2 SMITH ISLAND CABLE-LAYING OPERATIONS

Staging for the cable installation to Smith Island will be at the Coast Guard Station, Port Angeles, Washington. The cable will be installed from the potentially rougher (weather and sea) area around Smith Island to the calmer site off Whidbey Island. Installation procedures will be similar to those employed at Cape Flattery and Destruction Island. Data on the catenary forces and angles of the communications cable being laid in these deep water conditions are given in a separate section of Appendix F.

It is not anticipated that any cable protection will be required at either end of the cable in this particular location. After completion of the cable-laying, and after final electrical checks on the cable are made, the *POINT COUNTESS* will take the YC-1092 in tow and head for the Coast Guard Base, Seattle, Washington. A detailed schedule of operations from Neah Bay departure to demobilization in Seattle is given in Figure 24.

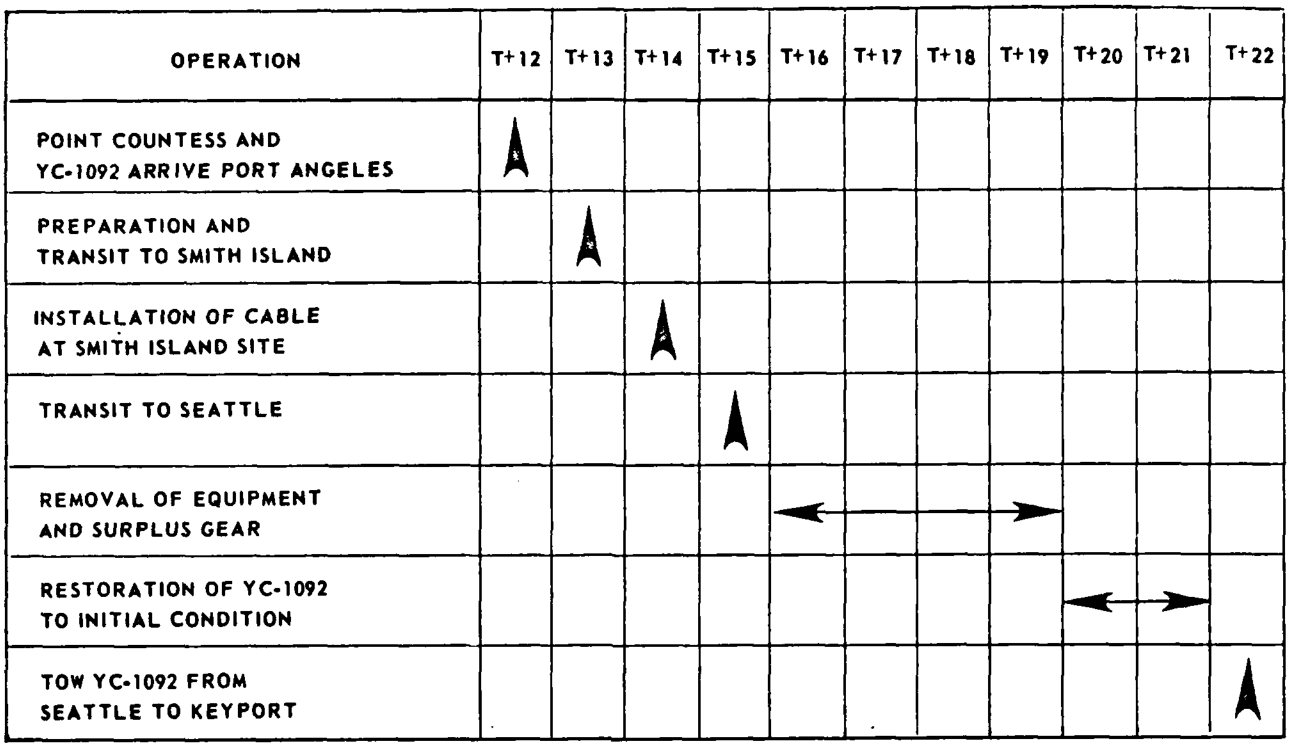
8.0 DEMOBILIZATION AND DOCUMENTATION

8.1 DEMOBILIZATION

The spare ITT cable, offloaded from the YC-1092 at the Coast Guard Station, Neah Bay, will be placed on reels and trucked back to the Coast Guard Base at Astoria, Oregon by Coast Guard personnel. When the YC-1092 reaches the Coast Guard Base, Seattle, Washington, the remaining surplus communications cable will be removed, put on reels, and also shipped back to Astoria by the Coast Guard.

SCHEDULE OF SMITH ISLAND INSTALLATION AND DEMOBILIZATION

FIGURE 24



At Seattle, the barge will be off-loaded of all gear by Coast Guard personnel at the Base. In addition to the cable this includes cable bin framing, cable-stayed fairlead frame, chutes, cable brake and bases, Seabee gear, surplus anchors, etc. The barge will be repaired as necessary and restored to its original condition. It will then be towed by the Coast Guard back to the U. S. Naval Torpedo Station, Keyport, Washington.

8.2 FINAL REPORTS

The final report on this phase of the LAMP, that is providing shore power to the Cape Flattery, Destruction Island, and Smith Island Lighthouses will be prepared by CHESNAVFACENGCOM for the U. S. Coast Guard in accordance with the interagency agreement under which this project has been carried out. Input for this report will be provided by the UCT-2 Seabee personnel and the 13th Coast Guard District personnel involved in the project execution.

APPENDIX A

PROCEDURES FOR UNDERWATER CABLE ROUTE SURVEYS TO SMITH ISLAND, CAPE FLATTERY, AND DESTRUCTION ISLAND LIGHTHOUSES

CODE FPO-1C3

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
WASHINGTON, D. C. 20374

Procedures for Underwater Cable Route Surveys to Smith Island, Cape Flattery, and Destruction Island Lighthouses

1. PROJECT DESCRIPTION

1.1 Background. The Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) provides support for the U. S. Coast Guard Lighthouse Automation and Modernization Program (LAMP). LAMP has as its goal the full automation of all Coast Guard lighthouses, which will enable the Coast Guard to remove its personnel from these outposts. CHESNAVFACENGCOM is supporting this project by installing underwater power cable to priority lighthouses. To accomplish this support, CHESNAVFACENGCOM has conducted feasibility studies, analyzed costs, investigated sites, surveyed cable routes, procured cable, performed project management, and installed cable.

1.2 Project Summary. The 13th Coast Guard District is in the process of automating two manned, off-shore lighthouses, Smith Island and Cape Flattery, and of converting the existing automated, unmanned Destruction Island Lighthouse from generator to shore power. A site investigation was performed at these lighthouses the week of 20 October 1975. A copy of the site investigation report is attached as Appendix B.

CHESNAVFACENGCOM, with the support of the 13th Coast Guard District and the U. S. Navy Underwater Construction Team - Two (UCT-2), will perform cable route surveys to the three lighthouses beginning 21 June 1976, for about ten days.

1.3 Site Locations. The three lighthouses are all within 150 miles of the Seattle headquarters of the 13th Coast Guard District, see figure 1-1.

1.3.1 Smith Island Lighthouse

--50 miles north of Seattle, 6 miles west of Whidbey Island at 48° 19.1' N. latitude and 122° 50.6' W. longitude.

--The cable route is to be on a direct line from Smith Island to the power source near the beach on Whidbey Island. Its approximate location is 48° 18.5' N. latitude and 122° 43' W. longitude.

--The staging location for the Smith Island Lighthouse survey will be at the Coast Guard Station at Anacortes on Fidalgo Island, directly north of Whidbey Island. Auto access to Anacortes: Interstate 5 about 65 miles north of Seattle, west on State route 20 to Anacortes.

--Applicable charts for Smith Island Lighthouse: C&GS 6382, 6401, 6380, 6450, 184 Small Craft and 6300 (Cape Flattery also); Geological Survey 15-minute series topographic maps with titles in State of Washington of Deception Pass, Richardson, and Anacortes.

1.3.2 Cape Flattery Lighthouse

--150 miles northwest of Seattle off Cape Flattery on Tatoosh Island at 48° 23.5' N. latitude, 124° 44.1' W. longitude.

--The cable route will parallel the existing charted cable runs from the north side of Tatoosh Island, eastward to northwest Neah Bay (western end of breakwater to Waadah Island).

--The staging for Cape Flattery is to be at the Neah Bay Coast Guard Station. From Seattle, take ferry routes west to US 101; at Port Angeles, take State Highway 112 through Clallam to Neah Bay.

--Applicable charts for Cape Flattery Lighthouse: C&GS 6102 (Destruction Island also), 6265, and 6266; Geological Survey of Cape Flattery.

1.3.3 Destruction Island Lighthouse

--Located 150 miles west of Seattle about 60 miles down the coast from Cape Flattery, at 47° 40.5' N. latitude and 124° 29.1' W. longitude.

--The cable route will be on a direct line southeast from Destruction Island to the power source at a state highway maintenance station where US 101 runs only a few feet from the beach. The approximate beach location is 47° 37' N. latitude and 124° W. longitude.

--The staging for Destruction Island will also be at the Neah Bay Coast Guard Station.

--Applicable charts for Destruction Island Lighthouse: C&GS 6102 (with insert for town of La Push), C&GA 6002; Geological Survey, Destruction Island, Forks, and La Push.

1.4 Survey Schedule. The survey schedule is tentatively based on: (a) the operational capability of the Coast Guard support vessel; (b) the weather; and, (c) the survey findings, which may warrant additional investigation.

1976

21 June - Monday	- Planning meetings at Anacortes; load and install gear on support vessel USCGC POINT COUNTESS.
22 June - Tuesday	- Transit to Smith Island Lighthouse area; establish locations for navigation instruments; perform depth recording runs.
23 June - Wednesday	- Perform diver surveys at planned shore approach of cable at Smith and Whidbey Islands.
24 June - Thursday	- Transit to Neah Bay for survey to Cape Flattery Lighthouse.
25 June - Friday	- Establish navigation locations to perform bottom depth recording runs.
26 June - Saturday	- Perform diver surveys at Tatoosh Island (Cape Flattery Lighthouse) and at planned terminal of cable near Neah Bay.

27 June - Sunday - Contingency and/or weather day; transit to location for survey to Destruction Island Lighthouse.

28 June - Monday - Establish navigation locations and perform bottom depth recording runs.

29 June - Tuesday - Perform diver surveys at Destruction Island and at shore terminal.

30 June - Wednesday - Off load equipment and transmit to Seattle area.

1.5 Support Vessel. The U. S. Coast Guard cutter POINT COUNTESS (WPB 82335) has been tasked to support the surveys at each of the three sites. The POINT COUNTESS is an 82-foot patrol craft, similiar to other Coast Guard cutters used successfully for the Chesapeake Bay and Long Island Sound cable route surveys. The vessel is based in Port Angeles, Washington, on Juan De Fuca Strait (somewhat equidistant between the three lighthouses). It will overnight at the two Coast Guard stations to be utilized as staging areas for the lighthouse surveys.

While no berthing is available on the cutters, occasional messing privileges can be arranged while operating at sea, or the use of the galley for the preparation of meals is permitted.

Two large holds aft can be used to store project and diver gear. In addition, 120-volt AC is available, and 24-volts DC may be available for navigation equipment.

A 16-foot powered boat is carried on the after deck and can be launched by boom. Diver operations can be conducted from this small boat or from a SEABEE Zodiac inflatable craft.

2. ORGANIZATIONAL RESPONSIBILITIES

2.1 CHESNAVFACENGCOM. CHESNAVFACENGCOM is under an interagency agreement with the Coast Guard Headquarters in Washington, D. C., to accomplish power cable installations for the various Coast Guard districts. For the cable route surveys to Smith Island, Cape Flattery, and Destruction Island, CHESNAVFACENGCOM will provide:

--Overall project engineering, management and coordination.

--Interface between all project participants.

--Navigation equipment and procedures.

--A project manager, assisted by a CHESNAVFACENGCOM engineer.

--Documentation responsibility, including a survey report.

The contact is: CHESNAVFACENGCOM
Building 57, Washington Navy Yard
Washington, D. C. 20374
202-433-3881 (Autovon 288-3881)
Code FPO-1C3 Hal Dorin

2.2 13th Coast Guard District. The 13th Coast Guard District has been generously supporting all phases of this project's goal: the installation of underwater power cables to Smith Island, Cape Flattery, and Destruction Island Lighthouses. For the cable route survey phase, the 13th Coast Guard District will provide:

--An 82-foot Coast Guard cutter as a survey platform.

--The support of various Coast Guard stations and the 13th Coast Guard District Headquarters.

--Electrical power aboard the cutter, the use of eight 12-volt batteries for the field navigation stations, and the use of two battery chargers.

--Site clearances for access to the lighthouse islands and the proposed shore power terminal areas.

--A 13th Coast Guard District representative to serve as liaison between the Coast Guard and Navy (CHESNAVFACENGCOM and UCT-2 SEABEE) units.

The contact is: Thirteenth Coast Guard District
Civil Engineering Branch
915 2nd Avenue
Seattle, Washington
206-442-5807
Lt. Greg Magee

2.3 UCT-2. UCT-2 has been able to schedule support for both the surveys and the planned September 1976 installations of the three cables. For the survey phase, UCT-2 will provide:

--A five-man diving and survey team, with the necessary diving equipment and supplies, who will inspect underwater cable approaches to the lighthouse islands and the shore landings at the power source end.

--Diver personnel to assist the navigation aspects of depth recording runs during nondiving periods.

--Certain navigation equipment, such as a portable depth recorder, transits (2), and tripods for transits (2).

--A written report (with underwater photographs) of the diving aspects of the survey.

The contact is: Thirty-First Naval Construction Regiment
Underwater Construction Team - Two
Port Hueneme, California 93041
805-982-5911 (Autovon 360-5911)
Lt. Bill Walker

3. SURVEY AND NAVIGATION EQUIPMENT AND PROCEDURES

3.1 Navigation Equipment. The following navigation equipment will be used for the lighthouse surveys:

--Motorola Mini-Ranger console with 2 transponders, 2 tripods for the transponders, 24-volt batteries to supply direct current to the console and transponders, and electrical cables for all units.

--Two transits, with tripods (UCT-2).

--Portable depth-recording system (UCT-2).

--Miscellaneous navigation tools and equipment.

--Navigation charts.

--Eight 12-volt batteries, with 2 battery chargers (13th Coast Guard District).

3.2 Shore End Diver Surveys. The SEABEE divers will perform diver surveys of the cable approaches to each lighthouse island and to each of the three mainland beach areas. Divers will inspect the sea bottom from the beach out to a depth of 60 feet along the cable route. The purpose of the surveys is to: (a) confirm the suitability of laying the cable along the planned route; (b) locate alternate approaches, if necessary; (c) identify obstructions or other bottom conditions that may be potentially hazardous to the cable and to record their location; (d) plot a route for placing the cable, should obstructions exist; (e) take photographs of each of the underwater approaches; and (f) record all data for presentation in the survey reports.

Although navigation and communication conditions will vary somewhat with each site, the following procedures will prevail for each survey:

--Divers enter the water from the beach or a small boat.

--Divers follow the compass bearing to a depth of 60 feet (the depth will vary somewhat at each site), recording bottom conditions.

--The small boat accompanying the divers on the surface will contain radios to communicate with navigation personnel on the beach.

--If feasible, a Mini-Ranger transponder will be placed in the boat to identify the range. If not, a hand-held, optical Rangematic Distance Finder will be used.

--The beach navigation personnel will direct the boat along its proper bearing (transit), and record the range to coordinate it with each diver's report.

3.3 Smith Island Cable Route Survey

CHARTS: National Ocean Survey (C&GS) 6450 and 184-SC
MAP: Geological Survey - Deception Pass, Washington

Chart surveys of the route and information gained during the site investigation indicate that a cable route on a direct line between the lighthouse and the beach landing site would be feasible. The true bearing between Smith Island Lighthouse and the beach is 093° (273°T from beach to lighthouse). (A tank shown as a navigational aid is 019°T from the lighthouse, and an aero beacon and radio tower are both about 75°T from the lighthouse.)

The Mini-Ranger console, and the depth recorder will be set-up on board the POINT COUNTESS. A Mini-Ranger transponder and transit will be set-up on the mainland. And, if possible, a transit will be located near the top of the lighthouse.

The transit operators will direct the survey vessel along the track from beach to beach. Mini-Ranger and bearing recordings will be taken, keyed to the precise time. The depth recorder paper (roll) will be marked by time of day. All data taken will be identified as to lighthouse, data, run, time, and specific data recorded.

3.4 Cape Flattery Cable Route Survey

CHART: National Ocean Survey - (C&GS) 6265 and 6266
MAP: Geological Survey - Cape Flattery, Washington

Because of the circuitous route from Cape Flattery Lighthouse (Tatoosh Island) to Neah Bay, a Mini-Ranger transponder and a transit will be used at each end. Navigational plots, utilizing both Mini-Ranger and transit (and a plot for the transit alone, in the event the Mini-Ranger fails to operate), will be developed prior to the survey.

3.5 Destruction Island Cable Route Survey

CHART: National Ocean Survey - (C&GS) 6002
MAP: Geological Survey - Destruction Island, Washington

Similar to Smith Island, the route from Destruction Island to the beach will be on a direct line, 127° true bearing from the lighthouse to the beach (307° T from beach to lighthouse). Transits will be set up at each end to facilitate sighting the survey vessel over the long range.

4. ADDITIONAL FACTORS

4.1 Weather. Periodic weather conditions and forecasts will be received via the Coast Guard radio network.

4.2 Communications. In addition to Coast Guard radio equipment and frequencies, other walkie talkie-type radios, with frequencies assigned for this type of operation, will be utilized.

4.3 Transportation. CHESNAVFACENGCOM, UCT-1, and the 13th Coast Guard District will have their own vehicular transportation at each of the mainland sites.

APPENDIX B

**REPORT OF
SITE INVESTIGATION DETAILS FOR POWER CABLE
INSTALLATION AT CAPE FLATTERY, SMITH ISLAND,
AND DESTRUCTION ISLAND LIGHTHOUSES**

CODE FPO-1C3

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
WASHINGTON, D. C. 20374

SITE INVESTIGATION DETAILS FOR POWER CABLE INSTALLATION AT
CAPE FLATTERY, SMITH ISLAND, AND DESTRUCTION ISLAND LIGHTHOUSES

ATTACHMENT 1. Specification for Thirteenth Coast Guard District Armored Communications Cable (Surplus)

2. Specification of ITT Three Conductor Power Cable

TRIP SCHEDULE

1. The trip schedule was as follows:

A. Monday - 20 October 1975 - Conference at ITT, Hydrospace Division, San Diego, CA regarding the purchase of 60,000 feet of used underwater power cable which is being offered for sale by ITT for about one-tenth its new commercial value. CHESNAVFACENGCOM is in the process of purchasing this cable for use on Coast Guard LAMP Projects.

B. Tuesday - 21 October 1975 - AM - Meeting at 13th CGD Headquarters, Seattle, WA.

C. Tuesday - 21 October 1975 - PM - Investigation of shore sites for the landing of cable from Destruction Island Lighthouse and commercial power available near these sites.

D. Wednesday - 22 October 1975 - AM - Cape Flattery Lighthouse cable shore landing site survey at Cape Flattery, Waatch River Inlet, and Neah Bay.

E. Wednesday - 22 October 1975 - PM - Transit by Army helicopter from Coast Guard Station at Neah Bay to Destruction Island, Tatoosh Island (Cape Flattery Lighthouse), and Smith Island.

F. Thursday - 23 October 1975 - AM - Site survey on Whidbey Island for shore landing site of cable to Smith Point.

G. Thursday - 23 October 1975 - PM - Meeting at 13 CGD Headquarters, Seattle, WA.

POWER CABLE AVAILABILITY SUMMARY

1. The three underwater cables which can be used for the lighthouses are as follows:

A. The 13th CGD possesses upwards to 100,000 feet of armored coaxial communications cable, Attachment 1, which is evaluated to be satisfactory for use as underwater power cable.

(1) An analysis of this cable by CHESNAVFACENGCOM personnel showed that a transmission voltage of 2700 volts would be required to yield a system with a regulation of 7%. A current of 2.59 amps at the 7000 watt power level is well within the current capacity of the cable.

(2) Electrically, the cable appears more than adequate, assuming it will pass the tests implied by the specification sheet and has not been degraded by time and/or improper handling and storage. Laboratory tests to verify the present condition of the cable are recommended for a representative length of the cable. In addition, inquiries as to cable splicing equipment and techniques should be initiated by the 13th CGD.

B. The 60,000 feet of used ITT cable, set forth in Attachment 2 is a more traditional, double armored power cable. Additional signal conductors for communications and/or automation equipment control have been incorporated into the cable.

C. CHESNAVFACENGCOM is presently purchasing for other Coast Guard Lighthouse Installations a new 15KV two conductor, concentric neutral URD power cable. This cable can be obtained unarmored, with a heavy polythylene jacket for about $1.00 per foot. It can be manufactured in long single lengths limited only by reel size and shipping constraints. Lengths in excess of six miles on a cable reel are feasible. The 15KV size, although electrically excessive to most Coast Guard requirements, has been chosen for the greater conductor size (for tensile strength), and for its weight, and increased center conductor insulation.

SITE INVESTIGATION SUMMARY

1. Cape Flattery Lighthouse.

A. The existing cable route to Tatoosh Island appears to be a satisfactory route and will be surveyed for the new power cable. A favorable approach to the lighthouse appears to be into the protected sandy cove on the north side of Tatoosh Island. The cable run to northwest Neah Bay (western end of breakwater to Waandah Island) is about 6NM. A commercial power source (pole) is located a few feet from the proposed cable landing beach site.

B. Other cable landing sites around Cape Flattery (from Neah Bay to Waatch Point) were investigated. The sites were not considered favorable (although the cable runs were shorter) due to the lack of nearby commercial power and the hazardous shore approaches.

C. Cable Recommendation: The double armored ITT cable (the three power conductors offer redundancy) is the first choice, however, the armored surplus communications cable could be used if the ITT cable is not obtained.

2. Smith Island Lighthouse.

A. The route from Smith Island to Whidbey Island measures approximately 5NM. If Minor Island light were to be included, an additional 1 to 1.5NM of cable would be required. From chart indications, a cable approach to Smith Island from the southeast would provide the most favorable underwater bottom slope (no more than 10%). The on-site inspection of Smith Island revealed a gradual approach up the beach and along the southern side of the island.

B. Bottom depth recordings will be taken during the cable route survey to assist in determining the best route to Whidbey Island. Bottom consistancy across the shipping channel appears ideal, with mud and sand predominating.

C. The recommended cable landing site on Whidbey Island is at the southwestern tip of Ault Field/Naval Air Station (approximately 48° 18.5'N, 122° 42'W). Commercial power is available near the edge of the Navy beach property.

D. Cable Recommendation: The water depth, bottom consistancy, and tide/current/weather conditions appear to favor the use of unarmored concentric neutral URD cable. The cable should be protected and/or buried at each end. However, as an alternate, the 13th CGD surplus communications cable could be used for this cable run.

3. Destruction Island Lighthouse

A. Original chart estimates for the shortest cable runs to Destruction Island were 3 to 3½ miles. The site investigation revealed both unfavorable and land terrain conditions and the lack of power at these beach sites.

B. About one NM north of Kalalock, at the State Highway Maintenance Station on U.S. 101, the highway passes along the beach within 100 feet of the ocean. The height above sea level is 10-20 feet and relatively gradual. Commercial power is available along this section of the highway. The cable run from this site to Destruction Island is about 6NM over a sandy bottom not exceeding 60 feet deep. Either of the two coves on the east side of Destruction Island (one with sign marking cable crossing) appear to be favorable approaches to the island.

C. Cable Recommendation: The use of the 13th CGD armored surplus communications cable is recommended at this site. The cable, because of its weight, should bury itself in the sandy bottom.

SUMMARY OF CABLE USE RECOMMENDATIONS

1. The following table summarizes the various cable use options and cost of cable for various options. It should be noted that the use of the surplus 13th CGD communications cable will significantly lower LAMP program cable costs.

LIGHTHOUSE	CABLE LENGTH AND 10%	OPTION (1) ALL SURPLUS CABLE 0% SPARE OR SLACK	OPTION (2) ITT PLUS SURPLUS CABLE	OPTION (3) ITT PLUS NEW URD	OPTION (4) SURPLUS AND NEW URD	OPTION (5) NEW URD CABLE ONLY
Cape Flattery	6.5NM	Surplus communications cable	ITT	ITT	Surplus communications cable	New URD
Smith Island	5.5NM	Surplus communications cable	Surplus communications cable	New URD	New URD	New URD
Destruction Island	6.5NM	Surplus communication cable	Surplus communications cable	New URD	Surplus communications cable	New URD
COSTS (EXCLUDING SPLICING)		NONE	$30,000 to $50,000 for ITT	$30,000 to $50,000 for ITT plus $72,000 URD	$33,000 URD Surplus NONE	$111,000 URD

NOTES: (1) Cable Splicing Equipment costs about $3,500 for each cable type.

(2) Cable Costs: 10NM ITT, $30,000 Armored, as is, or $50,000 with additional jute wrapping (add reel costs); unarmored 15KV URD about $6,000 per NM.

(3) ITT Cable at Cape Flattery will have 3.5NM spare.
- Surplus cable, option (1), no spare cable.
- Surplus cable, options (2) or (4), 3-4NM spare.

CABLE ROUTE SURVEY SCHEDULE

1. The cable route surveys are usually scheduled for completion six months to one year before cable installations. However, in order to install cable during calendar year 1976, the following schedule is proposed:

Cable Route Surveys - June 1976

Cable Installations - September 1976

Weather and window constraints require that the installations be made by CHESNAVFACENGCOM during the above periods.

13th CGD SUPPORT ITEMS

1. Certain long lead action items should be scheduled for completion by the 13th CGD immediately following the above cable route surveys. These items are:

A. Contractual agreements with the respective commercial power companies for each of the three lighthouses. The agreements should include provisions for the power companies to accept the end of a cable and provide hook-up to the power source. The power company should provide power source transition equipment (pole, transformer, meter and/or other equipment) and maintenance and repair service to this equipment. In some instances, due to local or state requirements, it may be easier for the power companies to obtain the necessary easements or right-of-way.

B. Easements and/or agreements from landowners (whether Federal Government, State of Local Government, Private, or other) for installation of the cable on their land, whether submerged or dry should be obtained. An agreement, usually verbal, should also be obtained to allow access to the property for the cable route survey.

C. Obtaining all the necessary permits, including:

(1) Environmental Protection Agency (EPA) Negative Declaration is usually submitted.

(2) Corporation of Engineers Permit.

(3) State and Local Permits, if required.

(4) Advertisements, Declarations, Announcements, Public Hearings, etc., as required.

CABLE ROUTE SURVEYS

1. The Cable Route Surveys will be conducted to determine and chart the most favorable cable path, and to determine the extent of cable protection and stabilization required at each end. CHESNAVFACENGCOM will plan and direct the surveys with the assistance of Navy Underwater Construction Team Two (UCT-2), Port Hueneme, CA. Most of the equipment and personnel required will be supplied. The 13th CGD is requested to support the surveys with vessels, and to provide necessary clearances, access to property, notification of local authorities, etc.

CABLE INSTALLATION

1. CHESNAVFACENGCOM will also plan and direct all at-sea aspects of the Cable Installations and, with UCT-2, provide most of the equipment, personnel, and necessary supplies. Navy and/or Coast Guard Vessels will be utilized. Support required by the 13th CGD will be similar to the cable route survey. At each of the three locations, Tatoosh Island (Cape Flattery), Smith Island, and Destruction Island, the cable must be run a significant distance (and height) over land from the beach landing to the lighthouse area. The burial and/or other protection and stabilization of these cables from the beach to the lighthouses will be the responsibility of the 13th CGD. Similarly, at the power source end of each cable, the 13th CGD will be responsible for trenching and protecting the cable in accordance with the prevailing local codes. The distances at each of the power source ends should be no more than 100 feet. The power companies may consider including this task as part of their contracted agreement.

NOTIFICATION REQUEST

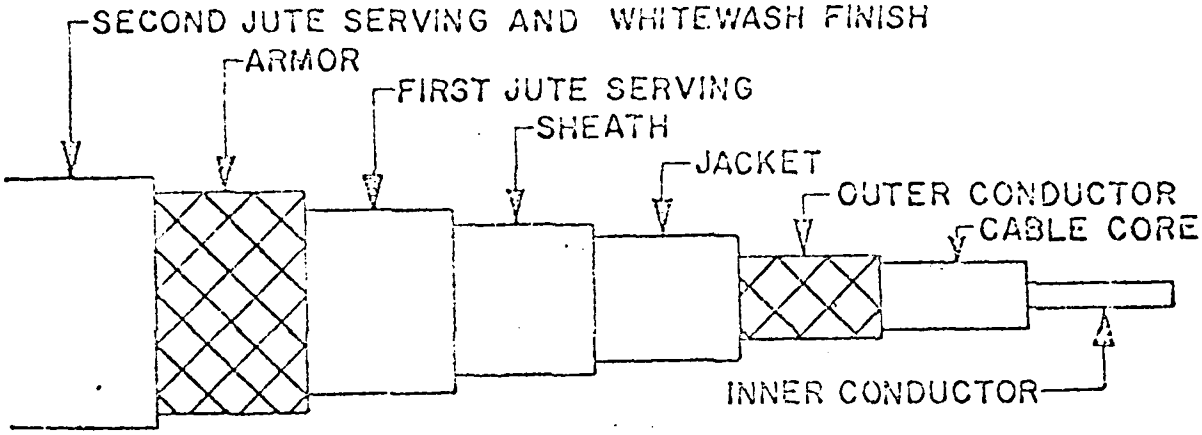
1. Due to vessel, personnel, and project commitments, it will be necessary for the 13th CGD to notify CHESNAVFACENGCOM in early June 1976 of its readiness and intention to proceed with the September 1976 installation. CHESNAVFACENGCOM contact is Mr. Harold P. Dorin, Code FPO-1C3, (202) 433-3881.

ATTACHMENT 1

Specification for
Thirteenth Coast Guard District
Armored Communications Cable (Surplus)

MIL-C-17/40A
4 MAY 1960
SUPERSEDING
MIL-C-17/40
7 SEPTEMBER 1955

CABLE, RADIOFREQUENCY, COAXIAL, RG-85A/U



Description	Constructional details
Inner conductor	Bare copper wire. Nominal diameter, 0.1045 ±0.0015 inch.
Cable core	Solid, type A. Overall diameter, 0.680 ±0.010 inch.
Outer conductor	Single braid, AWG size 30 bare copper wire. Overall diameter, 0.760 inch maximum. *Alternate* Carriers ...... 24 .... 36 .... 48 Ends .... 14 .... 9 .... 7 Picks/inch .... 3.1, ±10 percent .. 4.0, ±10 percent .. 5.6, ±10 percent
Jacket	Type IIa. Overall diameter, 0.870 ±0.015 inch.
Sheath	A lead sheath shall be applied over the jacket to a diameter of 1.000 ±0.015 inch. The sheath shall be of commercially pure lead (not less than 99.85 percent pure) and without flaws. It shall be tightly formed about the cable jacket. The sheath shall be applied concentrically to obtain a variation no greater than ±10 percent in the wall thickness of the sheath.
First jute serving	A serving of one layer of 70-pound asphalted jute, composed of 25 ends, shall be applied over the lead sheath with a left-hand lay of 4 ±¼ inches. The asphalted jute shall be of the best commercial grade available.
Armor	A galvanized-steel-wire armor, BWG size 10, consisting of 24 wires shall be applied over the first jute serving with a right-hand lay of 9 ±1 inches. The wire shall be soft annealed wire, throughly and evenly galvanized. The wire shall have a tensile strength of not less than 50,000 pounds per square inch, and the elongation in 8 inches shall be not less than 12 percent, as tested before application to the cable.
Second jute serving	A serving of one layer of 16/3 asphalted jute, composed of a minimum of 27 ends, shall be applied over the armor with a left-hand lay of 3½ ±¼ inches. The asphalted jute shall be of the best commercial grade available.
Whitewash finish	*A whitewash or other anti-stick material shall be applied over the second* jute serving. The whitewash shall be made with the best slaked lime commercially available.
Completed cable	Overall diameter, 1.565 inches maximum.

APPENDIX C

DESCRIPTION OF THE
CABLE LAYING AND MAINTENANCE MACHINE
CLAMM

CODE FPO-1C3

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
WASHINGTON, D. C. 20374

CLAMM

(Cable Laying And Maintenance Machine)

CDR C. L. Clark
Chief, Civil Engineering Branch
Thirteenth Coast Guard District

The key to reliable power and communications transmission via submarine power cable is the availability of properly equipped and trained personnel to periodically inspect, repair and replace suspect segments of the system. The Thirteenth District has always had well qualified personnel to maintain the sixty miles of submarine cable, but was sorely lacking in the equipment department. Muscle power and a 40 ft. UTB were the only tools available for maintenance in restricted waters. As a result, only an actual cable failure got attention.

Acquisition of an excess Cable Maintenance LCM was seriously considered. Transportation and overhaul costs would have exceeded $25,000. The LCM had additional operational drawbacks. Cable operation across the various inlets along the Washington and Oregon coast required hazardous transit in the open sea. Effective operation requires an assigned crew augmented by personnel with "local knowledge" while crossing the coastal bars. Cable repair and laying operations by LCM are possible but retrieval of abandoned cables would still take a lot of "Norwegian steam". Removal of as many as six abandoned cables at some sites was essential to permit future location and repair of the cable in service. Frustrating hours of retrieving dead cables had to be eliminated.

A joint effort of the Civil Engineeing Branch, Electronic Engineering Branch, and a Seattle company specializing in custom power line and telephone construction equipment produced the design for CLAMM. The complete machine shown in Figures 1 and 2 cost $10,040. Modifications to its Puget Sound barge added $5,627 the system total.

CLAMM's vital statistics are:

(1) Dimensions: Length 16'0", Width (operating) 11'0", Width (over the road) 8'0", Height 8'10".

(2) Weight: 9000 lbs. (empty).

(3) Reel Capacity: 6000 feet of 1¼" diameter cable.

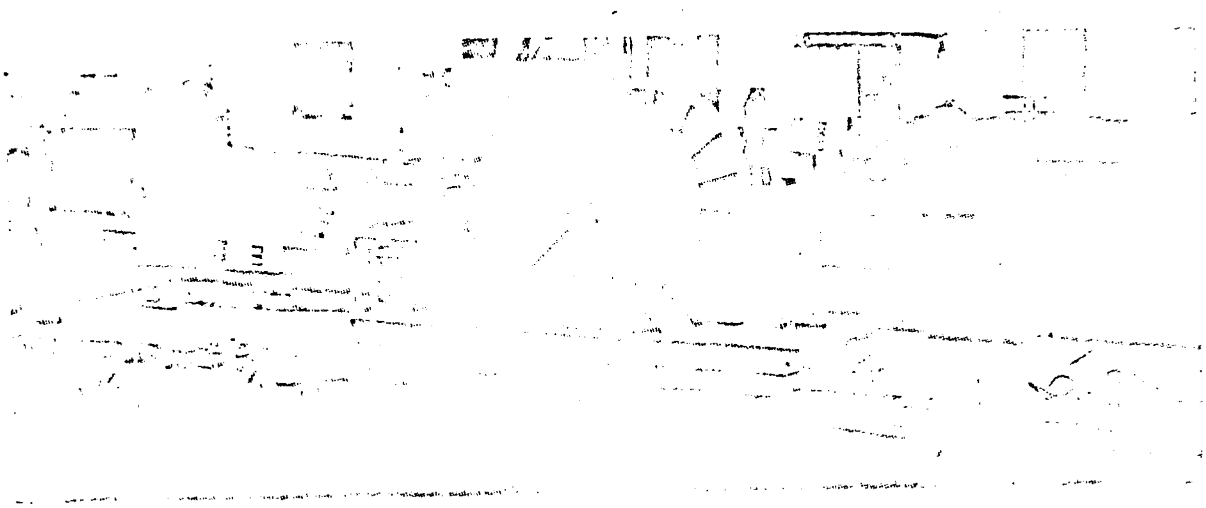
(4) Power Train: 18 HP air-cooled engine coupled to a Dusterlon #63/5 hydraulic motor. Drive from motor to reel by double sprocket chain.

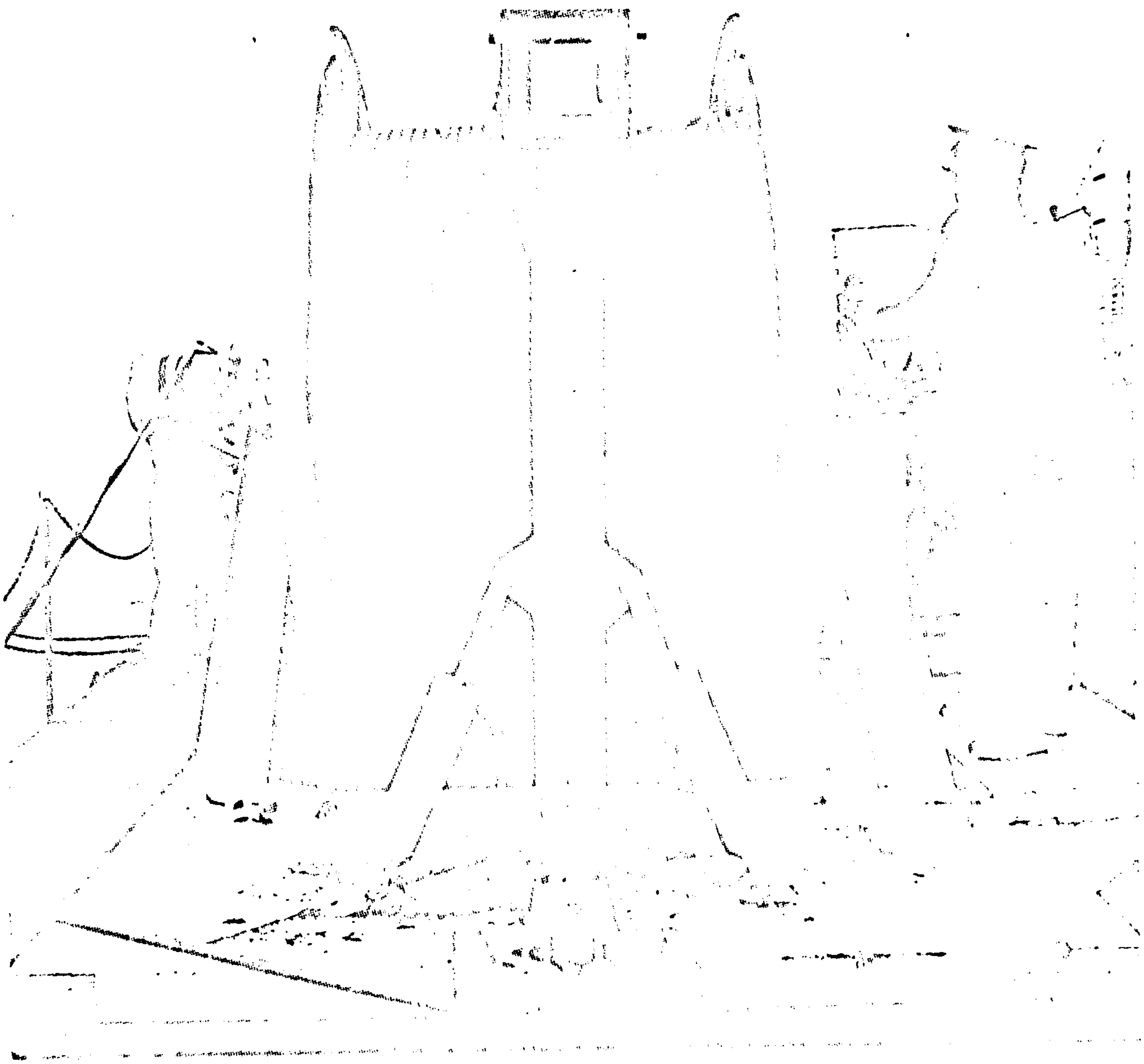
(5) Controls (Figure 3): Forward-Neutral-Reverse
Variable speed and power in both directions
Level wind left-right with adjustable feed speed

Reel speed and power are adjustable by the operator to match the specific evolution. Cable speed can be varied from 0 fpm to 300 fpm. Pulling power at 5 fpm is 5000 lbs. and reduces to 500 lbs. at 300 fpm. Three recent projects illustrate the value of CLAMM.

CLAMM is easily transported by truck to any site. Rental of a small barge at the coastal ports is no problem. Ninety percent of our cable work is in Puget Sound so it is normally on its own barge. Improved safety and cleanliness adds to our satisfaction with CLAMM.

	Before CLAMM (based on cable maintenance records)	*With CLAMM*
(1) Lay new power cable & retrieve old cable	42 manhours (total time, 7 hours)	3 manhours (total time, 1 hour)
(2) Lay new power cable & retrieve old cable	25 manhours (total time, 5 hours)	4 manhours (total time, 1 hour 15 min)
(3) Relocate control cable & lay new power cable	20 manhours (total time, 4 hours)	2 manhours (total time, 1 hour)





CLAMM

Dimensions

Length	- 16' 0"
Width	- 8' 0" (less winch drum and operator's pedestal)
Width Overall	- 11' 0" can be reduced to 8' wide for road transportation
Height	- 8' 10"
Weight	- Approximately 9000 lb.

Reel Dimensions

Outside Diameter	- 96"
Core Diameter	- 48"
Core Width	- 52"

Reel Capacity

1 1/4" Cable - 6000' (Approximately)

Drive Train

Power - 18 HP Wisconsin Air Cooled Engine
Dusterion #63/5 Hydraulic Motor
Chain (Double Sprocket) from motor to reel

Controls

Forward-Neutral-Reverse
Continuously adjustable speed and power in both Forward and Reverse
Level wind guide arm - left-right adjustable speed

Working Data

Reel speed is continuously adjustable from 0 feet per minute (FPM) of cable payout - take in to a maximum speed of 300 FPM. Reel operates at same speeds in both Forward and Reverse.

Reel provides a minimum pull of 500 lbs at 300 FPM and is continuously adjustable to a maximum pull of 5000 lbs at 5 FPM. (Tested reel to 5500 lbs.)

Note: By using CLAMM an estimated 70 man-hours were saved on three jobs already completed.

APPENDIX D

DATA ON LARC V AND ON THE BOSTON WHALER EXTRACTED FROM THE OCEAN CONSTRUCTION PLATFORM COMPENDIUM

CODE FPO-1C3

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
WASHINGTON, D. C. 20374

☐ GEOMETRY AND HYDROSTATICS: THE LARC V (LIGHTER AMPHIBIOUS RESUPPLY CARGO) IS A VEHICLE WHICH IS CAPABLE OF BEING OPERATED ON BOTH LAND AND WATER. THE AMPHIBIOUS LIGHTER HAS AN OVERALL LENGTH OF 35.00 FEET, A MAXIMUM WIDTH OVER THE FENDERS OF 10.00 FEET AND A MAXIMUM HEIGHT TO THE TOP OF THE CAB OF 10.17 FEET. THE TOTAL NET WEIGHT, DRY, IS 19,000 POUNDS WHILE THE TOTAL GROSS WEIGHT IS APPROXIMATELY 30,000 POUNDS. THE CARGO DECK, WHICH IS CAPABLE OF TRANSPORTING A MAXIMUM PAYLOAD OF 10,000 POUNDS, IS 16.00 FEET LONG, 9.75 FEET WIDE AND HAS A DEPTH OF 2.42 FEET. THERE IS A LOADED CLEARANCE OF 2.00 FEET BETWEEN THE HULL AND THE GROUND. AN OVERHEAD CLEARANCE OF 10.33 FEET IS REQUIRED FOR THE TRANSPORTATION OF THE LARC V.

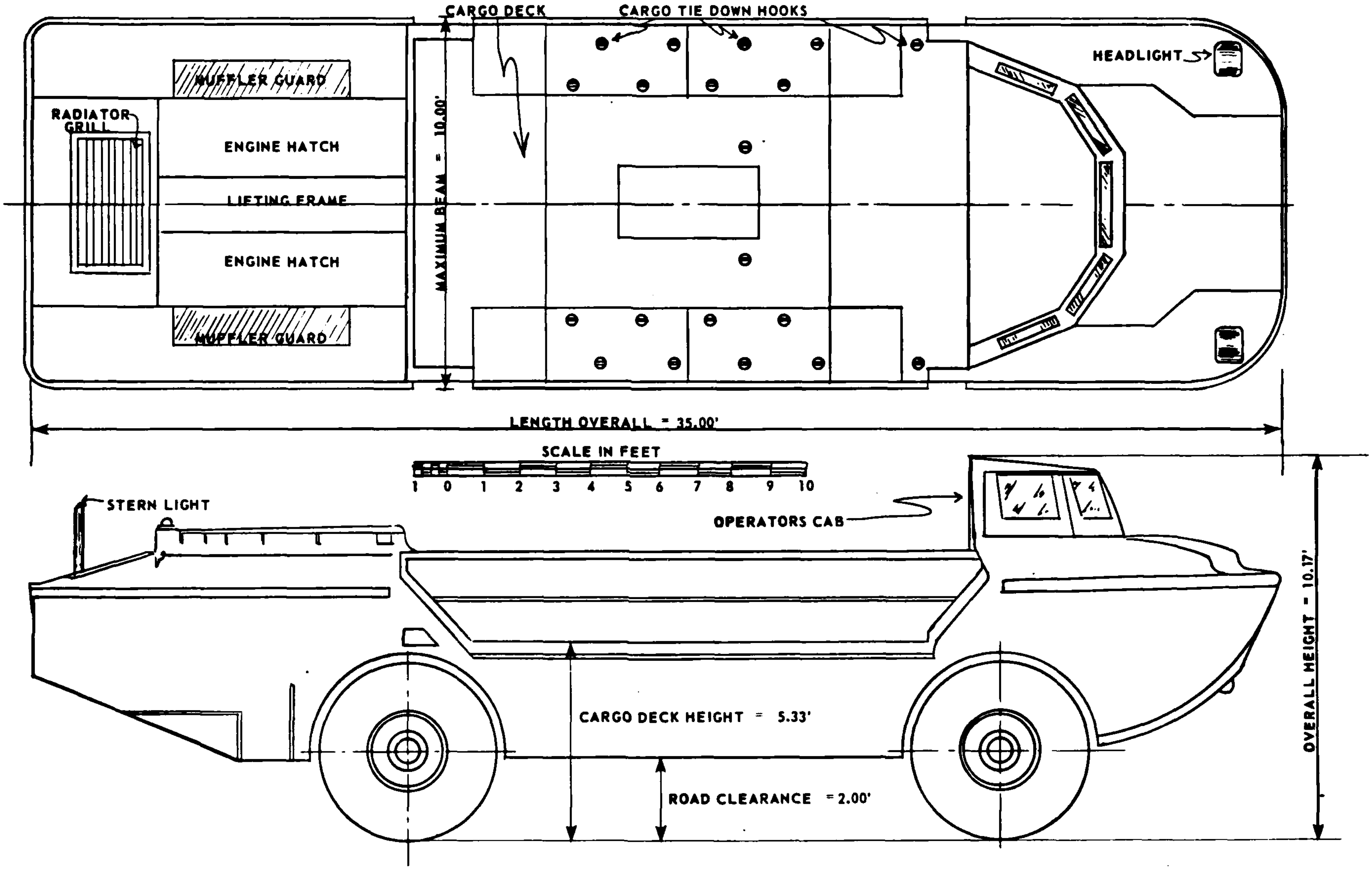
☐ STRUCTURE: THE VEHICLE IS CONSTRUCTED WITH AN ALUMINUM FRAME SUPPORTING AN ALUMINUM HULL, DECK, AND CAB. THE LIGHTER IS MOUNTED ON FOUR RIGIDLY SUPPORTED WHEELS AND THE STRUCTURE IS DESIGNED TO SUPPORT THE TOTAL CRAFT WEIGHT ON DIAGONALLY OPPOSITE PAIRS OF WHEELS OVER THE RANGE OF VERTICAL ACCELERATIONS THAT MAY BE ENCOUNTERED. AN ALUMINUM CANOPY CAN BE INSTALLED TO COVER THE CAB IN THE CASE OF INCLEMENT WEATHER. THE FLUSH DECK HAS A HIGH CENTER OF GRAVITY WHICH FACILITATES THE SELF-BAILING FEATURE.

☐ OUTFIT: THE VESSEL REQUIRES A CREW OF TWO PERSONS FOR ITS OPERATION. THE CARGO DECK IS FITTED WITH TEN CARGO TIE DOWN HOOKS AND FOUR LOAD CENTERING DEVICES. THERE ARE TWO HEADLIGHTS LOCATED AT THE FRONT OF THE VEHICLE AND ONE STERN LIGHT. TO PROVIDE ACCESS TO THE ENGINE, THE VEHICLE HAS TWO ENGINE HATCHES, TWO MUFFLER GUARDS, FOUR ENGINE HATCH HANDLES AND ONE LIFTING FRAME. TWO MANUAL BILGE PUMPS ARE INCORPORATED FOR USE IF THE THREE HYDRAULIC BILGE PUMPS FAIL. A MARKER BUOY LOCATES THE LIGHTER IF IT SHOULD SINK IN LESS THAN 100 FEET OF WATER. FOUR 18:00 X 25 TIRES WITH A 12 PLY RATING ARE USED TO SUPPORT THE VEHICLE. PRESSURES OF 9 PSIG AND 18 PSIG ARE RECOMMENDED FOR THE FRONT TIRES FOR SOFT AND HARD TERRAIN RESPECTIVELY WHILE 14 PSIG AND 22 PSIG ARE RECOMMENDED FOR THE REAR TIRES ON SOFT AND HARD TERRAIN RESPECTIVELY. FOUR DRY-CHARGED, TWELVE VOLT, 100 AMPERE HOURS BATTERIES ARE USED. THE TWO FUEL TANKS HAVE A CAPACITY OF 72 GALLONS EACH.

☐ MACHINERY AND PROPULSION: THE ENGINE IS AN INDUSTRIAL GASOLINE ENGINE OF 270 GROSS HORSEPOWER AT 3200 RPM OF WHICH 30 HORSEPOWER IS CONSUMED IN THE AUXILIARY EQUIPMENT LEAVING 240 HORSEPOWER FOR PROPULSION. FOR WATER PROPULSION, A 30 INCH DIAMETER, 30 INCH PITCH PROPELLER IS USED WHICH IS LOCATED IN A HOUSING AT THE REAR OF THE CRAFT WITH A ROAD CLEARANCE OF 1.33 FEET. THE LIGHTER IS CAPABLE OF TRAVELING AT A MAXIMUM SPEED OF 30 MPH ON LAND AND 10 MPH IN THE WATER. THE HIGH RANGE OPERATING RADIUS WITH NO LOAD ON LAND IS 250 MILES AND IS 40 MILES IN WATER. FOR A FULL LOAD, THIS OPERATING RADIUS IS DECREASED TO 200 MILES ON LAND BUT REMAINS 40 MILES IN THE WATER. SPEED LOSS DUE TO WAVE ACTION IS TO BE EXPECTED AND IS DIFFERENT ONLY IN DEGREE BETWEEN THE AMPHIBIAN AND A VESSEL OF SIMILAR DIMENSIONS. FOR THE LARC V SPEED LOSSES COMPARED TO STILL-WATER SPEED AT 225 PROPELLER HORSEPOWER ARE 2% FOR 1.2-LENGTH WAVE, 16% FOR THE 2.0-LENGTH WAVE AND 7% FOR THE 4.0-LENGTH WAVE. THE CRITICAL WAVE LENGTH FOR THE LARC V IS 200 FEET.

☐ MANEUVERING AND CONTROL: THE POWER STEERING SYSTEM ON THE AMPHIBIOUS LIGHTER WILL PERMIT RELATIVELY EASY STEERING. BASICALLY, THE STEERING ON LAND IS ACCOMPLISHED BY FULL HYDRAULIC POWER AND IN WATER BY THE RUDDER. THE TYPE OF TERRAIN (SAND, MUD, OR HARD ROADS) WILL AFFECT LAND STEERING AS WITH ANY AUTOMOTIVE VEHICLE. UNDER IDEAL CONDITIONS SUCH AS HARD SMOOTH SURFACES THE OUTSIDE TURNING RADIUS IS 35.60 FEET WHILE THE INSIDE RADIUS IS 26.50 FEET. THE TURNING RADIUS WILL INCREASE AS THE TERRAIN BECOMES SOFTER. THE LIGHTER IS CAPABLE OF BEING STEERED IF THE HYDRAULIC POWER SHOULD BE LOST BUT MUCH MORE STEERING EFFORT WILL BE REQUIRED; IN WATER THE STEERING WHEEL WILL TURN THE FRONT WHEELS AND THE RUDDER AT ALL TIMES. THE AMPHIBIOUS LIGHTER IS CAPABLE OF GOING UP EXTREMELY STEEP GRADES AS HIGH AS 60%. THE VEHICLES HAVE AN ANGLE OF APPROACH OF 31 DEGREES AND AN ANGLE OF DEPARTURE OF 28 DEGREES.

☐ MISSION SUPPORT: THE ALUMINUM AMPHIBIOUS LIGHTER IS USED TO CARRY CARGO FROM AN OFF-SHORE SUPPLY SHIP TO A BEACH FOR ADVANCED BASE SUPPLY WITH A TOTAL CARGO CAPACITY OF 10,000 POUNDS. IT ALSO SERVES AS A DIVE BOAT OR POWER SUPPLY FOR UNDERWATER WORK. IT ALSO CAN BE USED FOR MOVING PERSONNEL AND EQUIPMENT ACROSS BOTH LAND AND WATER FROM A BASE TO A CONSTRUCTION SITE.



INSHORE OPERATIONS LOGISTICS PLATFORM OVERALL GEOMETRY	LIGHTER, AMPHIBIOUS, RESUPPLY, CARGO: LARC V

☐ **GEOMETRY:** THE BOSTON WHALER IS A FIBERGLASS BOAT WHOSE CONSTRUCTION UTILIZES A STRUCTURAL FOAM CORE FOR HULL INTEGRITY AND RIGIDITY. THERE ARE PRESENTLY TEN DIFFERENT MODELS OF BOSTON WHALERS BEING BUILT, WITH OVERALL LENGTHS RANGING FROM 9'2'' TO 21'4''. THE MAXIMUM BEAM RANGES FROM 4'4'' TO 7'4''. THE OUTRAGE 19, TYPICAL OF THE BOSTON WHALER SERIES, IS USED ON THE FOLLOWING PAGE TO ILLUSTRATE THE OVERALL GEOMETRY OF THESE PLATFORMS.

☐ **HYDROSTATICS:** THESE BOATS, WHICH HAVE A HIGH STRENGTH-TO-WEIGHT RATIO, RANGE IN WEIGHT FROM 125 LBS. TO 1800 LBS.

☐ **STRUCTURE:** THE RESULT OF THE SANDWICH METHOD OF CONSTRUCTION IS A BOAT WITH GREAT HULL STRENGTH AND FLOTATION. IT PROVIDES A RIGID FOAM CORE THAT IS STABLE, INCREASING THE LIFE OF THE BOAT. FOAM COMPLETELY FILLS THE SPACE BETWEEN THE INSIDE AND OUTSIDE HULLS AND WELDS ITSELF TO THE FIBERGLASS SKINS TO FORM A RUGGED ONE-PIECE UNIT. THE FIBERGLASS SKIN IS SUPPORTED OVER ITS ENTIRE SURFACE INCREASING THE HULL'S RIGIDITY AND STRENGTH.

☐ **SEAWORTHINESS:** BOSTON WHALER HULLS HAVE BEEN DESIGNED WITH SEAWORTHINESS AS A PRIME OBJECTIVE. THE FORWARD HULL SPONSONS GIVE THE BOAT STABILITY AT REST. THE SAME SPONSONS DIG IN WHEN THE BOAT IS BEING PUSHED BY A FOLLOWING SEA, EXPOSING, IN EFFECT, THREE KEELS TO THE WATER. THE BLUNT, FULL BOW SECTIONS OF BOSTON WHALERS GIVE EXTRA BUOYANCY WHEN PLUNGING INTO HEAVY SEAS. THE COMBINATION OF THE HIGH FOAM VOLUME AND THE LOW FREEBOARD GIVES BOSTON WHALERS A GREAT SAFETY MARGIN SHOULD A BOAT BE DAMAGED OR SWAMPED. THE HIGH FOAM VOLUME ENSURES FLOTATION EVEN IN THE WORST CONCEIVABLE CIRCUMSTANCES. THE LOW FREEBOARD POSITIONS THE ENGINE POWER HEAD ABOVE GUNWALE LEVEL AND THEREFORE ALWAYS ABOVE WATER AND CAPABLE OF BEING RUN. THE LOW FREEBOARD NOT ONLY CONTRIBUTES TO SAFETY BUT ALSO MAKES THE BOATS MORE FUNCTIONAL AS PLATFORMS AS THEY ARE LESS AFFECTED BY CROSSWINDS MAKING THEM EASIER TO MANEUVER IN STRONG WINDS.

SPECIFICATIONS

MODEL	DIMENSION A	BEAM	WEIGHT (LB.)	MAXIMUM HORSEPOWER	MINIMUM HORSEPOWER	SWAMPED BUOYANCY
SQUALL 9'	9'2''	4'4''	125	3	-	600 LBS.
STANDARD 11'	11'4''	5'0''	210	10	-	750 LBS.
SPORT 11'	11'4''	5'0''	220	20	-	750 LBS.
SPORT 13'	13'4''	5'5''	300	40	9.5	950 LBS.
SPORT 15'	15'3''	5'8''	450-500	75	25	1650 LBS.
SPORT 17'	16'7''	6'2''	650-850	100	40	2000 LBS.
SAKONNET/MONTAUK 17'	16'7''	6'2''	770-900	100	40	2000 LBS.
BASS BOAT/NEWPORT 17'	16'7''	6'2''	950	100	40	2000 LBS.
OUTRAGE/REVENGE 19'	19'4''	7'4''	1500-1600	170	65	4000 LBS.
OUTRAGE/REVENGE 21'	21'4''	7'4''	1600-1800	200	65	3700 LBS.

INSHORE OPERATIONS LOGISTICS PLATFORM PHYSICAL CHARACTERISTICS	TYPICAL BOSTON WHALERS

☐ OUTFIT: EACH COMPONENT THAT IS ADDED TO THE HULL STRUCTURE OF THE BOSTON WHALER IS DESIGNED TO PERFORM A SPECIFIC FUNCTION. THE RAILS, MADE OF STAINLESS STEEL, ARE FAR STRONGER AND MORE RESISTANT TO CORROSION THAN NORMAL ALUMINUM RAILS. THE BOW RAILS ARE HIGH TO PROVIDE SECURITY AND SAFETY FOR THE BOATS' OCCUPANTS. FOR MAXIMUM RIGIDITY AND LEVERAGE THE RAILS ARE SECURED WITH TWO STANCHION SUPPORTS, ONE HIGH AND ONE LOW. THE BOW CHOCKS, MADE OF CAST BRONZE, ARE DESIGNED TO PREVENT RUB RAIL WEAR. HEAVY DUTY RUB RAILS ARE SECURELY FIXED TO THE HULL AND HAVE AN INSERT WHICH IS EASILY RENEWED IF NECESSARY. OUTRIGGERS ON THE 16's, 19's, AND 21's ARE MOUNTED ON THE CONSOLE RAIL IN SPECIALLY DESIGNED ALUMINUM CASTINGS. STERN LIGHTS ON THE 19- AND 21-FOOT BOATS ARE SIX FEET ABOVE THE FLOOR AND HAVE AN ANTI-GLARE SHIELD FOR NIGHT WORK. SEATING OPTIONS MAY BE INSTALLED IN MANY OF THE 17-, 19-, AND 21-FOOT MODELS BECAUSE OF THEIR SPACIOUS INTERIORS. THE OPTIONS ADD TO THE VERSATILITY OF THE BOAT AND ENABLE THE OPERATOR TO CUSTOM RIG THE BOAT FOR HIS NEEDS. FIVE OF THE COMMON OPTIONS INCLUDE UPHOLSTERED SWIVEL SEAT, REVERSIBLE PILOT SEAT, 4 MAN SEAT, REVENGE STORAGE SEAT, AND COOLER SEATS.

☐ MACHINERY AND PROPULSION: THE BOSTON WHALER SERIES CAN BE PROPELLED THROUGH THE WATER WITH A VARIETY OF ENGINES RANGING IN POWER FROM A SINGLE 10 HORSEPOWER ENGINE ON THE 13-FOOT MODEL TO TWIN 85-HORSEPOWER ENGINES ON THE 19- AND 21-FOOT OUTRAGE MODELS FOR A COMBINED TOTAL POWER OF 170 HORSES. THE RANGE OF SPEEDS FOR THE SERIES IS FROM 18 MPH WITH A 13-FOOT BOAT TO A TOP SPEED OF 44 MPH WITH A 19-FOOT OUTRAGE. THE AVERAGE SPEED FOR THE SERIES IS BETWEEN 30 AND 35 MPH. THE TABLES BELOW GIVE SPEEDS WHICH ARE APPROXIMATE AND CAN VARY WITH MAKE AND CONDITION OF ENGINE, WIND AND WATER CONDITIONS, AND BOAT DISPLACEMENT.

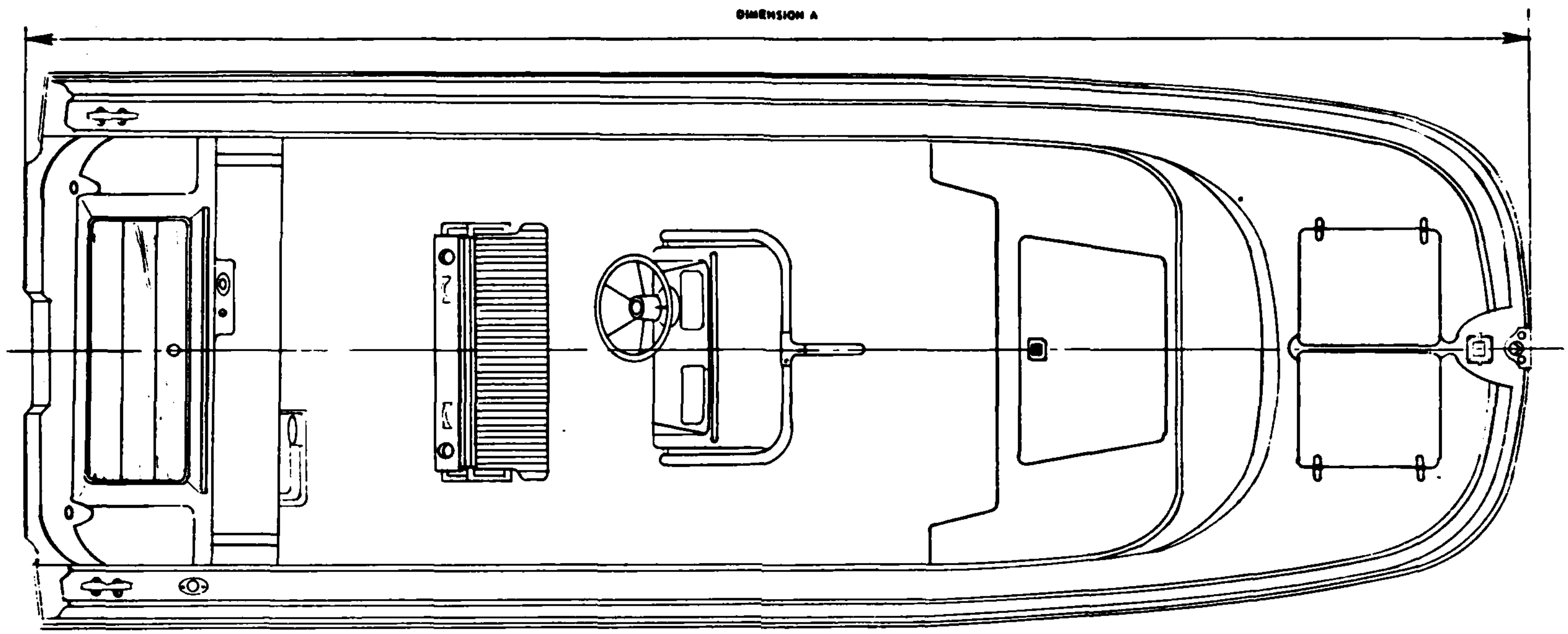
SINGLE ENGINE PERFORMANCE IN MILES PER HOUR

HORSEPOWER	10	20	40	50	65	85	115	135	150
13'4"	18	25	36						
16'7"			26	30	34	38			
19'4" OUTRAGE					30	34	40	42	44
21'4" OUTRAGE					28	32	36	40	42
19'4" REVENGE						30	34	37	38
21'4" REVENGE						28	32	35	36

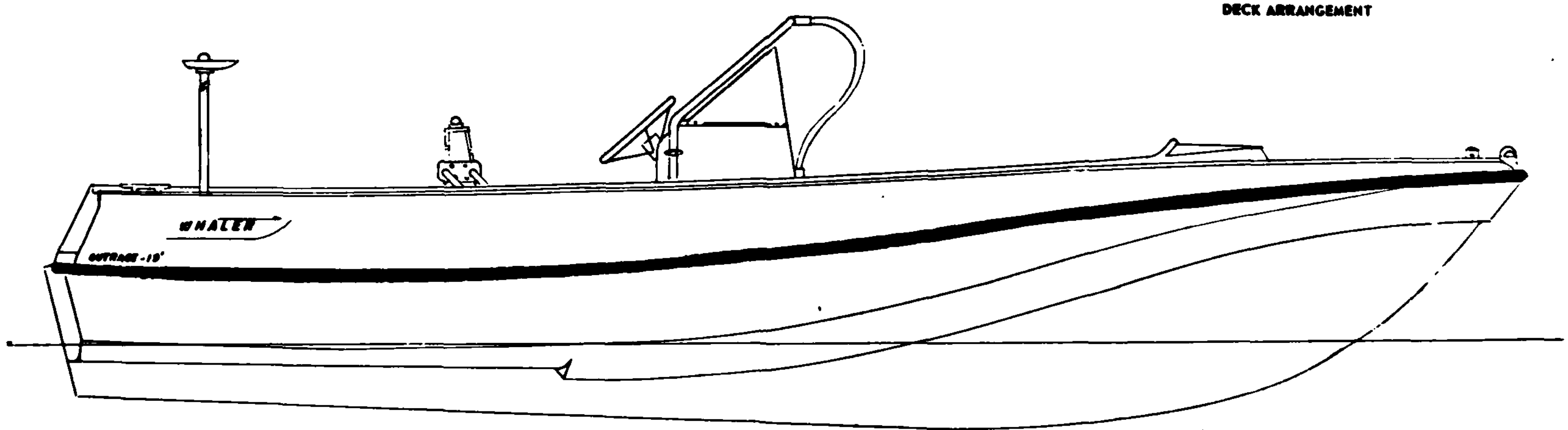
DUAL ENGINES PERFORMANCE IN MILES PER HOUR

HORSEPOWER	2-40'S	2-50'S	2-65'S	2-85'S
19'4" OUTRAGE	30	34	38	44
21'4" OUTRAGE	28	32	36	42

INSHORE OPERATIONS LOGISTICS PLATFORM PHYSICAL AND PERFORMANCE CHARACTERISTICS	TYPICAL BOSTON WHALERS



DECK ARRANGEMENT



OUTBOARD PROFILE

INSHORE OPERATIONS LOGISTICS PLATFORM OVERALL GEOMETRY	TYPICAL BOSTON WHALER

APPENDIX E

WEATHER, TIDE, AND CURRENT CONDITIONS AT THE INSTALLATION SITES

CODE FPO-1C3

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
WASHINGTON, D. C. 20374

RELEVANT GEOGRAPHICAL AND ENVIRONMENTAL INFORMATION EXCERPTED FROM UNITED STATES COAST PILOT 7, PACIFIC COAST, CALIFORNIA, OREGON, WASHINGTON, AND HAWAII ELEVENTH EDITION - JUNE 1975

TIDE TABLES 1976 - HIGH AND LOW WATER PREDICTIONS

TIDAL CURRENT TABLES 1976 - SLACK WATER AND MAXIMUM CURRENT VELOCITIES

Queets River is the largest stream between Grays Harbor and Cape Flattery. The S point is a low, sandy spit about 0.1 mile long, projecting from an abrupt cliff, 80 feet high, and densely wooded. The N point is 1.3 miles long, low, and sandy, with some trees at the mouth of the river, and a narrow lagoon between it and the bluff.

From Queets River for 10 miles to abreast Destruction Island, the coast is rather low and is broken by cliffs about 50 feet high with broad low-water beaches. **Kalaloch Rocks** lie about 4.5 miles N of the river, close inshore.

Destruction Island, 90 feet high, is 20 miles NNW of Cape Elizabeth and 3 miles offshore. It is flat-topped and covered with brush, with a few clumps of trees. The island is 0.5 mile long and 300 yards wide at its S part. From the N end rocks and ledges extend about a mile from the cliffs; these are bordered by a line of kelp on the inshore side.

Destruction Island Light (47°40.5'N., 124°29.1'W.), 147 feet above the water, is shown from a 94-foot white conical tower with black gallery on the SW part of the island; a fog signal is at the light.

An indifferent anchorage, affording shelter from NW winds, may be had off the SE face of the island in 10 fathoms, sandy bottom, with the light bearing between **293°** and **315°**. Vessels must leave if the wind hauls W or S. During the fishing season many small fishing boats anchor for the night under Destruction Island; it is the only shelter from offshore winds between Grays Harbor and Cape Flattery.

Chart 18480 (6102).-For 5.5 miles from Destruction Island to Hoh Head, the coast trends in a general NW direction. The cliffs are 50 to 100 feet high, and many rocks and ledges extend 1.2 miles offshore in some places.

Abbey Islet, 3.5 miles NE of Destruction Island, is over 100 feet high and covered with trees. It is 200 yards off the cliffs. Many rocks lie close S of it, the most distant of which is **South Rock,** 46 feet high, 1 mile S, and 0.5 mile offshore.

At the mouth of **Hoh River,** 2 miles SE of Hoh Head, is a broad sand beach; the absence of cliffs for 0.5 mile is noticeable for a considerable distance offshore. In smooth weather the river can be entered by canoes, but the channel shifts. An Indian village is on the S bank at its mouth.

Hoh Head, 200 feet high, is a bright yellow cliff covered with a dense forest. It projects a little over 0.5 mile from the general trend of the coast. A large cluster of rocks is off the S cliff of the head and covered rocks extend to about 1.6 miles offshore between the head and North Rock. A rock covered 2¼ fathoms lies 1.8 miles WNW of Hoh Head.

Middle Rock, North Rock, and **Perkins Reef** are other dangers within 1.5 miles off Hoh Head. Middle Rock, 65 feet high and black with vertical sides, is 0.8 mile off the mouth of Hoh River. North Rock, a mile S of Hoh Head, is 107 feet high and grayish in color, with steep sides; in the afternoon sun this rock shows white, which makes it a very distinct landmark. Perkins Reef is a long, bold, and jagged islet, 1.1 miles W of Hoh Head. This area has numerous other rocks, covered and bare.

The coast continues rugged and rocky from Hoh Head to La Push, 11 miles to the NW. The cliffs are 100 to 120 feet high, broken here and there by small streams. Several rocky islets 25 to 120 feet high and covered ledges extend in some places as much as 2 miles offshore.

Alexander Island, 121 feet high, is 2 miles NNW of Hoh Head and a mile offshore. It is covered with low vegetation, and is flat-topped with steep sides. The island is prominent in hazy or smoky weather. A covered rock, 1.8 miles WNW of Alexander Island, is the outermost known danger in this vicinity.

Toleak Point, 4.7 miles NW of Hoh Head, is a narrow point terminating in a small knob with an abrupt seaward face. A high wooded islet lies 400 yards W of the point, to which it is connected by an extensive bare reef. **Rounded Islet,** a grassy rock 130 feet high with steep sides, is 0.3 mile seaward of Toleak Point. A low black rock is 0.7 mile S of the islet.

Giants Graveyard, 1.5 miles N of Toleak Point, consists of very irregular rocks; the largest are up to 210 feet high. The farthest offlying rock is about 0.8 mile from shore.

Teahwhit Head, 8 miles NW of Hoh Head and 2.4 miles SSE of La Push, is a jagged double point 100 feet high and heavily wooded. **Strawberry Bay,** on the SE side of the head, is a small bight in which fishing boats find shelter from NW winds. There are numerous rocks in and around the bight.

Quillayute Needle, 81 feet high, 1.3 miles WNW of Teahwhit Head, is the outermost of many rocks, visible or covered, that lie within a mile of the shore. Some are as high as 100 to 195 feet, and many are awash or covered by a fathom or less. The foul area continues to James Island, at the entrance to La Push.

James Island, 15 miles NNW of Destruction Island on the N side of Quillayute River mouth, is 183 feet high, bold and wooded, and joined to the beach at low water. Numerous smaller wooded islands, immediately N, are prominent. An indifferent anchorage affording some shelter from NW winds may be had close SE of James Island, in 5 to 6 fathoms, sandy bottom, about 600 yards from the beach. Sea swell makes this anchorage unsafe.

James Island Light (47°54.3'N., 124°38.8'W.), 150 feet above the water, is shown from a white house on the S part of the island. A radiobeacon and fog signal are at the light.

La Push, an Indian village on the E bank and about 0.4 mile above the entrance of **Quillayute River,** is an important sport fishing center. The river channel is protected by a jetty on the SE side and a dike on the NW side; a lighted whistle buoy is about 1.8 miles SW from the outer end of the jetty.

The river channel leads from the sea to a small-craft basin at La Push. In 1972, the controlling depth was 10 feet to the entrance of the basin; depths of about 10 feet were reported available in the basin in 1973. The N and S sides of the entrance to the basin are marked by lights. A power cable with a clearance of about 100 feet crosses the river near its mouth.

The channel, which passes close to the SE shore of James Island, is sometimes dangerous, especially in heavy S weather. Weather conditions which make the entrance hazardous normally occur only in the winters, usually in December and January. When there are breakers of any size making across the entrance, it should not be attempted except at better than half tide and with a well-powered boat. Strangers may request assistance from the La Push Coast Guard station by radio or signals; a Coast Guard boat will lead the vessel in if practicable. The tank at the Coast Guard station is prominent.

Weather.-Maritime air from over the Pacific has an influence on the climate throughout the year. In the late fall and winter, the low-pressure center in the Gulf of Alaska intensifies and is of major importance in controlling weather systems entering the Pacific Northwest. At this season of the year, storm systems crossing the Pacific follow a more S path striking the coast at frequent intervals. The prevailing flow of air is from the SW and W. Air reaching this area is moist and near the temperature of the ocean water along the coast which ranges from 45° F. in February to 57° F. in August. The wet season begins in late September to October. From October through January, rain may be expected on about 26 days per month; from February through March, on 20 days; from April to June, on 15 days; and from July to September, on 10 days. As the weather systems move inland, rainfall is usually of moderate intensity and continuous, rather than heavy downpours for brief periods. Gale force winds are not unusual. Most of the winter precipitation over the coastal plains falls as rain; however, snow can be expected each year. Snow is seldom deeper than 10 inches or remains on the ground longer than 2 weeks. Annual precipitation increases from about 90 inches near the coast, to more than 120 inches over the coastal plains, to 200 inches or more on the wettest slopes of the Olympic Mountains.

During the rainy season, temperatures show little diurnal or day to day change. Maximums are in the forties or minimums in the mid-thirties. A few brief outbreaks of cold air from the interior of Canada can be expected each winter. Clear, dry, cold weather generally prevails during periods of E winds. Maximum temperatures range from 25°F. to 35°F. and minimums from 10°F. to 25°F.

In the late spring and summer, a clockwise circulation of air around the large high-pressure center over the North Pacific brings a prevailing NW and W flow of cool, comparatively dry, stable air into the NW Olympic Peninsula. The dry season begins in May with the driest period between mid-July and mid-August. The total rainfall for July is less than 0.5 of an inch in 1 summer out of 10; also, it exceeds 5.0 inches in 1 summer out of 10. During the warmest months, afternoon temperatures are in the upper sixties and lower seventies, reaching the upper seventies and the lower eighties on a few days. Occasionally, hot, dry air from the E of the Cascade Mountains reaches this area and maximum temperatures are in the mid- or upper-nineties for 1 to 3 days. Minimum temperatures are in the upper forties and the lower fifties. The lowest relative humidity and greatest danger of forest fires occur with E winds.

In summer and early fall, fog or low clouds form over the ocean and frequently move inland at

night, but generally disappear by midday. In winter, under the influence of a surface high-pressure system, centered off the coast, fog, low clouds, and drizzle occur daily as long as this type of pressure pattern continues. The average frost-free season is from the last of April until mid-October.

The National Weather Service maintains an office at the Quillayute Airport about 3 miles inland from the coast; **barometers** may be compared here. **Storm warning display** locations are listed on NOS charts and shown on the Marine Weather Services Charts published by the National Weather Service. (See page T-5 for Quillayute **climatological** table.)

The Coast Guard has established a **rough bar advisory sign**, 34 feet above the water, visible from the channel looking seaward, on the NW corner of the Coast Guard boathouse, to promote safety for small-boat operators. The sign is diamond shaped, painted white with an international orange border, and with the words "Rough Bar" in black letters. The sign is equipped with two alternating flashing amber lights. The lights will be activated when seas exceed 4 feet in height and are considered hazardous for small boats. Boatmen are cautioned, however, that if the lights are not flashing, it is no guarantee that sea conditions are favorable.

About 350 berths, electricity, gasoline, diesel fuel, water, ice, a launching ramp, and some marine supplies are available at the basin at La Push. A 3-ton hoist can handle craft to 24 feet; however, no repairs can be made at the basin. A good highway connects La Push with U. S. Highway 101 N of Forks.

From James Island NNW for 16.4 miles to Cape Alava, the rugged coast continues, with rocks and foul ground extending as much as 2 miles offshore; the land side consists of steep wooded bluffs and narrow beaches. The cliffs, however, are not continuous. The once densely timbered country ascends gradually E to the snow-capped mountains of the Olympic Range, which can be seen for many miles in clear weather. In 1974, areas of heavy logging activity were in evidence inland for many miles from this coastal area.

Cake Rock, 116 feet high, is 2 miles NW of James Island and 1.5 miles offshore. This rock, about 200 yards long, has steep sides and its flat top is surmounted by a 20-foot mound. There are several other visible rocks between Cake Rock and the shore.

Cape Johnson, small and not particularly prominent, projects less than 0.5 mile from the coastline, terminating in a vertical cliff 100 feet high.

Jagged Islet, 78 feet high, 2.6 miles NW of Cape Johnson, is large, brown, covered with guano, and irregular in outline. A low black rock lies 200 yards N. **Carroll Islet**, 225 feet high, is 0.8 mile N of Jagged Islet. It has vertical whitish sides and wooded top. A pillar rock, 134 feet high, lies 200 yards W, and a low black rock is 200 yards off the SE side. Carroll Islet and the pillar rock are quite prominent, especially in the sunlight.

Bald Islets are two high, bare rocks inside of Jagged and Carroll Islets about 0.8 mile offshore. The outer and larger one is 320 feet high with steep sides, and the smaller is 183 feet high. They are 200 yards apart, and between them are two pinnacle rocks close together. Many other rocks are shoreward of the islets.

Hand Rock, 33 feet high, is 1.5 miles N of Carroll Islet and 1.5 miles offshore. So named from its shape, the rock is black with a white cap of guano on top.

White Rock, 161 feet high, 1.7 miles S of Cape Alava and about 0.8 mile offshore, has nearly vertical sides and a rounded top; it is whitish, and in the sunlight is visible for a long distance. A group of large, low, black rocks lie 0.8 mile SSE of White Rock and 0.8 mile offshore. A rock covered 6 fathoms is 2.2 miles W of White Rock.

Chart 18485 (6265).-Cape Alava, the westernmost point of the State of Washington, is 13 miles S of Cape Flattery. The seaward face is about 0.6 mile in extent. **Iskawahyah Island**, a steep rocky island, 142 feet high and with trees on top, is off its NW extremity. The shore is bordered by numerous rocks and covered ledges.

The several fixed lights along this otherwise remote stretch of shoreline are associated with the year-round operation of the Ozette Archaeological Expedition which was established at an abandoned Indian village site on Cape Alva in 1970.

Flattery Rocks and **Umatilla Reef** are rocks and islets extending W from Cape Alava for 2.3 miles. **Ozette Island**, 236 feet high, is 0.8 mile SW of the cape. The island, 0.5 mile long, is flat-topped with steep sides. About 0.3 mile off the S and SE sides are low, black rocks. **Bodelteh Islands**, 1.2 miles WNW of the N end of Cape Alava, have high bold seaward faces. The outer one is 198 feet high.

In season, a few fishermen find shelter in an anchorage off the SE end of Ozette Island. The area is small and requires local knowledge to enter. It affords fair protection from the prevailing NW wind.

Umatilla Reef, 2.3 miles NW of Cape Alava, the greatest danger to navigation off the N coast, lies 0.7 mile W of the outer Bodelteh Island. It extends for 200 yards in a W direction and is about 75 yards wide. The reef consists of small, low, black rocks and some breakers. There is a reported breaker 1.1 miles NNE of this reef, and a rock covered 3 feet, 0.3 mile E of the reef, which endangers the passage inside Umatilla Reef, sometimes used by small boats. Umatilla Reef is difficult to make out, especially in thick weather. A lighted whistle buoy is 1.8 miles NW, and a lighted horn buoy is 1.7 miles WSW of the reef.

Between Cape Alava and Cape Flattery, the coast curves slightly in a series of bights, but continues as rugged as before. There are alternate

stretches of wooded bluffs and high rocky cliffs. The country immediately back of the beach is not high, but it is densely wooded.

Point of the Arches, 5 miles NNW of Cape Alava, is the N point of the cliffs that extend some 1.5 miles S. Numerous rocks and ledges are offshore as far as about a mile.

Father and Son, two rocks connected by a low reef, lie 0.6 mile offshore abreast the S end of the cliffs. The outer rock is 167 feet high, and the inner one 65 feet high. From the outer rock to Spike Rock there are several exposed rocks.

Spike Rock, 35 feet high, sharp and bare, is 0.8 mile NW of the Point of the Arches. It is the outermost of a chain of rocks, the largest of which is 185 feet high; there are three arches in these rocks. A rock that uncovers 5 feet is 0.3 mile WSW of Spike Rock.

Portage Head, 2.5 miles N of Point of the Arches, has a mile-long seaward face of bold irregular cliffs over 410 feet high. A reef extends from the point toward Cape Flattery for 1.5 miles showing several low, black rocks awash, and one small rock 45 feet high. A rock that uncovers is 1.3 miles NW of Portage Head.

Mukkaw Bay is a shallow bight included between Portage Head and Waatch Point. It affords indifferent shelter in N and E weather and a smooth sea, but is little used. During salmon runs many native pulling boats beach here at night. The shores are low and sandy. **Waatch River** enters in the N part of the bight immediately E of Waatch Point. It is a tidal slough, and the valley through which it runs extends about 2 miles to Neah Bay on the Strait of Juan de Fuca. This low depression is one of the features for recognizing Cape Flattery.

Waatch Point, 3 miles SE of Cape Flattery, is the SE extremity of the cliffs extending to the cape. This stretch is bordered by numerous rocks and ledges.

Fuca Pillar, 0.2 mile S of the W point of Cape Flattery, is a rocky column 157 feet high and 60 feet in diameter, leaning slightly NW. It is 150 yards off the face of the cliff, and is more prominent from N than from S.

Cape Flattery, a bold, rocky head with cliffs 120 feet high, rises to nearly 1,500 feet about 2 miles back from the beach. From S it looks like an island because of the low land in the valley of Waatch River. Numerous rocks and reefs border the cliffs E and S of the cape. Tide rips are particularly heavy off Cape Flattery.

Tatoosh Island, 0.4 mile NW of Cape Flattery, is about 0.2 mile in diameter, 108 feet high, flat-topped, and bare. It is the largest of the group of rocks and reefs making out 0.4 mile W. The passage between Tatoosh Island and the cape is dangerous and constricted by two rocks awash near its center. Although sometimes used by local small craft, it cannot be recommended. The currents are strong and treacherous.

(See page T-5 for Tatoosh Island climatological table.)

Cape Flattery Light (48°23.5'N., 124°44.1'W.), 165 feet above the water, is shown from a 65-foot white conical tower on a sandstone dwelling on the W end of Tatoosh Island. A radiobeacon and fog signal are at the light.

A rocky patch, covered 7½ fathoms, on which the sea breaks occasionally in a W swell, is 1.4 miles SW of the light.

Duncan Rock and **Duntze Rock,** the two principal dangers NNW of Tatoosh Island, lie respectively, 1 mile and 1.3 miles from the light. Duncan Rock is small, low, and black; Duntze Rock is covered 3¾ fathoms. A lighted whistle buoy is 500 yards NW of Duntze Rock. Ledges and rocks constrict the passage between Duncan Rock and Tatoosh Island to less than 0.5 mile, and strong currents and tide rips make it hazardous.

Chart 18480 (6102).-Swiftsure Bank, about 3.5 miles in extent, lies off the mouth of the Strait of Juan de Fuca, NW of the submarine valley making into the strait. The bank has a least depth of 19 fathoms.

During the summer, large numbers of fishing vessels may be trolling or at anchor on Swiftsure Bank. During periods of low visibility, which are not uncommon in this vicinity, extreme caution must be exercised to avoid collision with fishing boats; most of these craft tend to defy radar detection.

The Canadian Armed Forces have established a **firing practice and exercise area** in the approach to the Strait of Juan de Fuca, about 20 miles W of Cape Flattery. Vessels should exercise caution when navigating in this vicinity while exercises are in progress.

Carmanah Point to Amphitrite Point, Canada.-The coast from Carmanah Point to Cape Beale is very dangerous and, except during fine weather and offshore winds, should be given a wide berth.

Carmanah Point is on the Vancouver Island shore, 13 miles N of Tatoosh Island. A light, 175 feet above the water, is shown from a white octagonal concrete tower on the point; a fog signal and radiobeacon are at the light.

Clo-oose, a small village and mission, is 4 miles NW of Carmanah Point in the small cove at the mouth of the Cheewhat River, E of the entrance to Nitinat Lake.

A reef 0.8 mile long in a NW direction, with a rock awash in its center, is off this cove. It is marked by a lighted whistle buoy 0.8 mile SW of the rock.

Tsusiat Lake is 8.5 miles NW of Carmanah Light. At the seaward end of the lake is a conspicuous waterfall which is visible far off even in hazy weather, and may help fix a vessel's position as it is the only waterfall on this part of the coast. Behind Tsusiat Lake the mountains rise to more than 2,000 feet.

Pachena Point, 25 miles NW of Cape Flattery, is marked by a light; a fog signal is at the light.

Seabird Rocks are off the entrance to Pachena Bay, 3 miles NW of Pachena Point. The largest is about 48 feet high, bare, and of small extent; it is marked by a light. There is no safe passage between Seabird Rocks and the shores NE, and the rocks should not be approached closer than 1.5 miles.

Cape Beale is a bold rocky point, 120 feet high. A reef with rocks above and below water extends about 0.8 mile SW from it. A light, 170 feet above the water, is shown from a white slatted daymark on a red square skeleton tower near the W extremity of the cape; a fog signal and a marker radiobeacon are at the light.

Barkley Sound, an extensive arm of the sea 35 miles NW of Cape Flattery, lies between Cape Beale and Amphitrite Point. It is 15 miles wide at its entrance, and though encumbered by numerous islands and rocks, it maintains a breadth of 13 miles for 8 miles inland, above which it separates into several narrow inlets. The shores are low, except in the N part and among the inlets, where they become high, rugged, and mountainous.

In the W part of the sound are innumerable rocks and islands with navigable channels between them. Entrance should not be attempted without local knowledge or a pilot. **Imperial Eagle Channel** is the easiest of access.

Amphitrite Point is the W entrance point of Barkley Sound. A light, 58 feet above the water, is shown from a white rectangular tower on the end of the point; a radiobeacon and fog signal are at the light. A whistle buoy is 0.6 mile S of the point.

A more detailed description of Canadian waters is given in Pub. No. 154, Sailing Directions (Enroute) for British Columbia, published by the Defense Mapping Agency Hydrographic Center, and the Sailing Directions, British Columbia Coast, (South Portion) Vol. I, published by the Canadian Hydrographic Service.

Routes.-In clear weather no difficulty will be experienced in approaching the entrance to the Strait of Juan de Fuca from any direction, as the land on both sides is high and Cape Flattery is readily distinguished, particularly from S, owing to the low land between Mukkaw and Neah Bays. Lights, fog signals, and radiobeacons are available on both sides of the strait to assist in obtaining a fix.

In thick weather soundings will assist in estimating the distance from shore. Vessels should pick up the 100-fathom curve and be guided by the soundings. The relationship between the 100- and 50-fathom curve is a good indication for fixing the position; vessels should not proceed inside the 50-fathom curve until a fix has been obtained. The mountain peaks in the interior sometimes can be seen when the coast is obscured by fog.

Depths.-The depths in the approaches to the Strait of Juan de Fuca are very irregular, especially outside the 50-fathom curve. There is a deep submarine valley with depths of over 100 fathoms and a width of 2 to 4 miles, between the 100-fathom curves, which leads from about 37 miles SSW of Cape Flattery, rounds this cape at a distance of 2 miles, and extends about 32 miles into the strait. The 100-fathom curve on the W side of this submarine valley is very irregular, but on the E side it is more regular. Within the strait the curve is regular on both sides of the valley.

Currents.-The currents on Swiftsure Bank and at Umatilla Reef are described in the Tidal Current Tables. Off the entrance of the Strait of Juan de Fuca the coastal current is influenced by the flow into and out of the strait. On the flood there is a set into all the sounds on the Vancouver Island shore, and this, combined with the prevailing NW current and light S winds, with possibly some swell from the same direction, makes the coast in the vicinity and W of Carmanah Light dangerous, especially for small vessels. Many strandings have occurred on the Vancouver Island shore.

The flood current entering the Strait of Juan de Fuca sets with considerable velocity over Duncan and Duntze Rocks, but instead of running in the direction of the channel there is a continued set toward the Vancouver Island shore, which is experienced as far as Race Rocks. The flood current also has more velocity on the N shore of the strait than on the S.

The ebb current is felt most along the S shore of the strait, and between New Dungeness Light and Crescent Bay there is a decided set S and W, especially during large tides. With wind and swell against the current, a short choppy sea is raised near the entrance to the strait. (For additional information on currents in the Strait of Juan de Fuca, see chapter 12.)

Sailing craft approaching the strait should keep well off the mainland coast S of Cape Flattery, unless working to windward against a fine N wind, which is frequently found during the summer. In this case the coast may be approached to within 3 miles. At other times there is no inducement to hug the coast, on which a long rolling swell frequently sets, and this swell, meeting the SE gales of winter, causes a confused sea. The cape and its offlying dangers should be given a berth of at least 3 miles, as the tidal current sometimes sets with great velocity toward Duncan and Duntze Rocks. It is equally necessary when entering or leaving the strait to avoid the coast of Vancouver Island between Port San Juan and Bonilla Point, when there is any appearance of bad weather.

Sailing vessels making the strait during the winter, especially during November and December, and experiencing the E and SE winds prevalent at that season, should endeavor to hold a position S or SW of Cape Flattery, and should on no account open the entrance of the strait until an opportunity offers of getting well inside. It is also important to remember that, though it may be blowing strongly from the S or SSW outside, on rounding Cape Flattery, an E wind may be found blowing out of the strait, and a vessel would then

find the Vancouver Island coast a dangerous lee shore.

Coming from the W with a heavy W or NW gale and thick weather, vessels uncertain of their positions should lie-to on soundings at not less than 30 miles from the entrance or on the edge of the bank. These gales seldom last more than 12 hours, and if they veer toward the SW the weather will clear and vessels may bear up for the strait.

Fog.-The fog is generally heavier near the entrance, decreasing in density and frequency up the strait. Near the entrance the fog sometimes stands like a wall, and vessels entering the strait run out of it into clear bright weather, even before passing Tatoosh Island. The fog frequently extends a long distance seaward and, when combined with the smoke from forest fires, becomes exceptionally dense. The wind gradually works the fog into the strait, and it will follow the N shore past Port San Juan to the Sombrio River; occasionally it will reach as far as Sooke Inlet and at times to Race Rocks. As a rule, however, the fog moves farther into the strait along the S shore, at times reaching Port Townsend; frequently the N shore is clear when the S shore is enveloped in fog.

During the spring, fog is frequent in the strait. With the W wind it often stops at the headland between Crescent and Freshwater Bays, the fog then extending W while it is clear to E. When fog extends past Freshwater Bay the small area about the W bight will often be clear.

Weather.-In summer, the prevailing NW winds draw into the strait, increasing toward evening and at times blowing a 10-knot breeze before midnight. This occurs, however, only when the winds are strong outside. In light winds, sailing vessels may be a week from Cape Flattery to Admiralty Inlet, and vice versa.

In winter, SE winds draw out of the strait, causing a confused cross-sea off the entrance, the heavy SW swell meeting that coming out. Under these conditions small outboard vessels, especially sail, often make Neah or Clallam Bays and await more favorable weather. The weather off the entrance as a rule is exceptionally severe, and wrecks are of frequent occurrence. The heavy broken seas are probably due to the shoaling off the entrance, the irregularity and velocity of the currents, and the conflict between the wind drawing out of the strait and that along the outer coast.

The rainfall in the vicinity of the entrance is considerable, even during the summer, although the heaviest rains occur between December and March.

Charts 18485 (6265), 18484 (6266).-On the S side of the Strait of Juan de Fuca the coast trends E for 4 miles from Cape Flattery to **Koitlah Point,** the W point of Neah Bay. The shores are rugged, and the country is heavily timbered.

Neah Bay, about 5 miles E of Cape Flattery, is used extensively by small vessels as a harbor of refuge in foul weather. Its proximity to Cape Flattery and ease of access at any time make the anchorage very useful. It is protected from all but E weather.

Baadah Point, the E entrance point to Neah Bay, is rocky and grass-covered for some distance back from the shore. **Waadah Island,** 0.3 mile N of Baadah Point, is 0.5 mile long, high, and wooded. A rubblestone breakwater extends from the W side of the bay to about the middle of Waadah Island. A reef and foul ground extend 0.2 mile from the SW side of the island. A wharf, used by the Coast Guard, is on the S end of the island. A light and fog signal are at each end of the island. A reef that bares, marked by a lighted bell buoy, extends 500 yards NW from **Dtokoah Point,** SE of the entrance.

The buildings of the Coast Guard station, 0.4 mile SW of Baadah Point, are prominent from the entrance.

The buoyed entrance to the bay is between Waadah Island and Baadah Point. Depths of 14 to 16 feet can be carried into the bay. The careful navigator can carry 16 feet through the entrance by use of the chart and by favoring the S side of the entrance, passing the lights close aboard that mark the ends of the Makah Indian T-head pier about 375 yards W of Baadah Point. After passing the lights let the chart be the guide to the best water. Anchorage is in 4 to 6 fathoms, sandy bottom.

The W shore of Neah Bay is high and precipitous, and bordered by craggy rock outcroppings. The shore E of the village of Neah Bay is a low sand beach to Baadah Point. The unmarked wreck of a 32-foot fishing vessel in 37 feet of water and covered 28 feet, is near the middle of the bay in 48°22'25"N., 124°36'50"W.; mariners are advised to exercise caution when anchoring in the vicinity of the wreck.

The Indian village of **Neah Bay,** on the SW shore of the bay, is the site of considerable sport fishing and logging. Logs are trucked to a boom on the breakwater, 900 yards from the W end, where rafts are made up.

Neah Bay is a **customs port of entry.** The customs officer also performs **immigration** duties. (See appendix for address.)

The Makah Indian T-head pier with a 300-foot face and privately marked at each end by a light, and the ruins of a T-head pier no longer visible, are about 375 and 500 yards SW of Baadah Point. Caution is advised in the vicinity of the pier in ruins, as submerged piles may exist. The Coast Guard pier is 0.5 mile W of Baadah Point.

Two cooperative fish piers, 1 mile and 1.2 miles SW of Baadah Point, have facilities for icing and supplying fishing boats. Limited berthage, electricity, gasoline, diesel fuel, water, and ice are available. Both piers have reported depths of 12 feet off the ends. There are many small-craft floats extending along the S shore of the bay. Neah Bay has no public haulout or repair facilities.

Storm warning display locations are listed on NOS charts and shown on the Marine Weather Services Charts published by the National Weather Service.

A paved highway extends along the Strait of Juan de Fuca to Port Angeles; telephone service is available.

Charts 18465 (6382), 18421 (6380).-Strait of Juan de Fuca, E end.-Hein Bank, with a least depth of 2¼ fathoms, lies 8.5 miles SE of Discovery Island; it is about 2 miles long in a N direction, within the 10-fathom curve, and 0.8 mile wide. The shoalest part of the bank is covered with thick kelp in the summer. It is marked by a lighted bell buoy.

Smith Island, 5 miles W of Whidbey Island and 8 miles ESE of Hein Bank, is irregular in shape and about 0.5 mile long. The E end is low, but rises abruptly to an elevation of 55 feet at its W end, terminating in a white perpendicular cliff composed of sand and gravel. Kelp extends from 1.5 miles W of the island, with a width of about 1.5 miles over depths of 4 to 6 fathoms; a rock covered 3½ fathoms lies about 1.8 miles W of the light. A rock that bares at lowest tides is about 0.3 mile W of the light. Strong currents set in and around the shoal area, especially on the flood, and deep-draft vessels should keep well outside the 10-fathom curve to avoid being set into danger. **Smith Island Light**(48°19.1'N., 122° 50.6'W), 97 feet above the water, is shown from a skeleton tower with a white square daymark near the W extremity of the island: a radiobeacon is at the station.

A **restricted area** of a air-to-surface weapon range is W of Smith Island. (See 204.220, chapter 2, for limits and regulations.)

Minor Island, small, low, and rocky, lies 1 mile NE of Smith Island, and at lowest tide is connected with it by a gravel and boulder spit. A light and fog signal are on the island.

The N part of **Whidbey Island** forms the E side of the Strait of Juan de Fuca. This part of the island has a uniform sandy shore backed by low and rolling upland of farm and wooded areas.

The aerolight (48°20.9'N., 122°40.2'W.) at Ault Field is conspicuous.

TIDAL DIFFERENCES AND OTHER CONSTANTS

No.	PLACE	POSITION		DIFFERENCES				RANGES		Mean Tide Level
				Time		Height				
		Lat. N	Long. W	High water	Low water	High water	Low water	Mean	Diurnal	
		° '	° '	h. m.	h. m.	feet	feet	feet	feet	feet
	WASHINGTON			on ABERDEEN						
867	Destruction Island	47 40	124 29	-1 01	-1 03	*0.87	*0.87	6.6	8.7	4.7
869	La Push, Quillayute River	47 55	124 38	-1 00	-0 47	*0.84	*0.84	6.5	8.5	4.6
871	Cape Alava (Flattery Rocks)	48 10	124 44	-0 53	-0 37	*0.81	*0.81	6.0	8.2	4.4
	Strait of Juan de Fuca [1]									
873	Cape Flattery, Tatoosh Island	48 23	124 44	-0 46	-0 46	*0.80	*0.80	5.8	8.0	4.3
875	Neah Bay	48 22	124 37	-0 37	-0 35	*0.78	*0.78	5.5	7.9	4.3
877	Clallam Bay	48 16	124 16	-0 11	-0 05	*0.76	*0.76	5.0	7.7	4.3
878	Twin Rivers	48 10	123 57	+0 02	+0 11	*0.71	*0.71	4.4	7.0	4.1
				on PORT TOWNSEND						
879	Crescent Bay	48 10	123 44	-2 34	-2 00	*0.81	*0.81	4.1	6.7	4.1
881	Port Angeles	48 07	123 26	-1 26	-1 21	*0.87	*0.87	4.2	7.2	4.4
883	Dungeness	48 10	123 07	-0 47	-0 36	*0.92	*0.92	4.4	7.6	4.7
885	Sequim Bay entrance	48 05	123 03	-0 32	-0 05	*0.95	*0.95	4.8	7.9	4.8
887	Gardiner, Discovery Bay	48 04	122 55	-0 40	-0 15	*0.95	*0.95	4.8	7.9	4.8
889	Smith Island	48 19	122 50	-0 06	-0 23	*0.84	*0.84	4.2	7.0	4.5
891	Point Partridge	48 14	122 46	-0 04	-0 13	*0.93	*0.93	4.5	7.7	4.7

CURRENT DIFFERENCES AND OTHER CONSTANTS

No.	PLACE	POSITION		TIME DIFFERENCES		VELOCITY RATIOS		MAXIMUM CURRENTS			
								Flood		Ebb	
		Lat.	Long.	Slack water	Maximum current	Maximum flood	Maximum ebb	Direction (true)	Average velocity	Direction (true)	Average velocity
		° '	° '	h. m.	h. m.			deg	knots	deg.	knots
	WASHINGTON—BRITISH COLUMBIA COAST			on SAN FRANCISCO BAY ENTRANCE							
	Time meridian, 120°W.	N.	W.								
795	Quillayute River entrance	47 55	124 38	-0 20	-0 20	0.1	0.4	015	0.3	195	1.3
800	Cape Alava, 4.4 miles west of*	48 10	124 50	-----	-----	----	----	----	----	----	----
805	Swiftsure Bank*	48 32	125 00	-----	-----	----	----	----	----	----	----
810	Vancouver Island, west coast§	-----	-----	-----	-----	----	----	----	----	----	----
	STRAIT OF JUAN DE FUCA			on STRAIT OF JUAN DE FUCA ENT.							
815	STRAIT OF JUAN DE FUCA ENTRANCE	48 27	124 35	Daily predictions				115	0.6	290	1.5
				on ADMIRALTY INLET							
915	Discovery Bay entrance	48 06	122 54	(*)	(*)	(*)	(*)	----	----	----	----
920	Smith Island, 2.0 miles east of	48 19	122 48	(*)	+0 35	0.2	0.2	----	0.4	220	0.5
925	Smith Island, 1.4 miles SSW. of	48 18	122 51	+0 10	+0 15	0.4	0.4	090	0.7	280	1.0
930	Smith Island, 3.7 miles ESE. of	48 18	122 45	(*)	+1 25	(*)	0.3	----	(*)	225	0.9
935	Point Partridge, 1.6 miles NW. of	48 15	122 48	-----	(*)	----	0.4	----	----	175	1.1
940	Point Partridge, 3.7 miles west of	48 14	122 52	(*)	+0 30	0.2	0.8	140	0.4	250	2.1

ABERDEEN, WASHINGTON, 1976

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

SEPTEMBER

DAY	TIME H.M.	HT. FT.	DAY	TIME H.M.	HT. FT.
1	0036	0.1	16	0021	1.4
W	0652	7.4	TH	0626	7.1
	1241	2.9		1220	3.8
	1848	9.7		1805	8.7
2	0139	0.2	17	0118	1.5
TH	0804	7.3	F	0732	7.0
	1348	3.2		1329	4.0
	1955	9.5		1914	8.6
3	0246	0.3	18	0221	1.4
F	0919	7.5	SA	0837	7.3
	1457	3.2		1439	3.8
	2102	9.5		2020	8.8
4	0349	0.1	19	0322	1.1
SA	1023	7.9	SU	0935	7.8
	1604	2.8		1542	3.3
	2207	9.5		2122	9.0
5	0445	-0.1	20	0418	0.7
SU	1118	8.5	M	1028	8.5
	1702	2.2		1641	2.4
	2303	9.6		2221	9.4
6	0533	-0.3	21	0510	0.3
M	1200	8.9	TU	1113	9.3
	1753	1.6		1732	1.5
	2355	9.7		2316	9.8
7	0619	-0.3	22	0558	0.1
TU	1238	9.3	W	1156	10.0
	1839	1.1		1822	0.5
8	0041	9.6	23	0011	10.1
W	0700	-0.2	TH	0642	0.0
	1310	9.5		1238	10.6
	1922	0.8		1909	-0.4
9	0119	9.5	24	0102	10.2
TH	0739	0.1	F	0726	0.2
	1342	9.7		1317	11.1
	2001	0.5		1956	-1.0
10	0158	9.3	25	0151	10.1
F	0817	0.5	SA	0809	0.5
	1411	9.7		1400	11.3
	2040	0.5		2042	-1.3
11	0235	8.9	26	0241	9.8
SA	0852	1.0	SU	0854	1.1
	1443	9.6		1444	11.3
	2119	0.5		2131	-1.3
12	0312	8.5	27	0334	9.3
SU	0929	1.6	M	0939	1.7
	1512	9.5		1531	11.0
	2158	0.7		2220	-1.0
13	0352	8.1	28	0432	8.8
M	1006	2.2	TU	1029	2.4
	1545	9.4		1623	10.6
	2240	0.9		2315	-0.5
14	0435	7.7	29	0534	8.3
TU	1043	2.8	W	1125	3.0
	1622	9.2		1722	10.0
	2325	1.2			
15	0525	7.3	30	0012	0.1
W	1125	3.4	TH	0642	8.0
	1706	9.0		1226	3.4
				1828	9.5

OCTOBER

DAY	TIME H.M.	HT. FT.	DAY	TIME H.M.	HT. FT.
1	0113	0.6	16	0037	1.6
F	0751	8.0	SA	0700	7.9
	1334	3.6		1300	4.3
	1938	9.1		1831	8.7
2	0216	0.9	17	0137	1.7
SA	0855	8.3	SU	0758	8.3
	1443	3.3		1409	3.9
	2048	9.0		1947	8.7
3	0319	1.0	18	0239	1.7
SU	0954	8.7	M	0854	8.9
	1549	2.8		1515	3.2
	2153	9.0		2056	8.9
4	0415	1.0	19	0337	1.6
M	1042	9.2	TU	0946	9.6
	1644	2.1		1615	2.1
	2251	9.2		2159	9.2
5	0503	0.9	20	0433	1.4
TU	1123	9.6	W	1033	10.4
	1733	1.4		1708	0.9
	2340	9.3		2257	9.7
6	0549	1.0	21	0523	1.3
W	1158	9.9	TH	1118	11.1
	1819	0.8		1759	-0.2
				2356	10.0
7	0027	9.4	22	0612	1.3
TH	0631	1.1	F	1203	11.7
	1231	10.1		1848	-1.1
	1859	0.4			
8	0105	9.3	23	0048	10.2
F	0709	1.4	SA	0659	1.5
	1302	10.2		1246	12.0
	1938	0.1		1936	-1.6
9	0143	9.2	24	0141	10.2
SA	0748	1.7	SU	0746	1.7
	1333	10.2		1332	12.1
	2015	0.0		2023	-1.8
10	0218	9.0	25	0232	10.0
SU	0825	2.2	M	0833	2.1
	1402	10.2		1418	11.9
	2053	0.1		2112	-1.7
11	0254	8.8	26	0327	9.7
M	0902	2.7	TU	0921	2.6
	1431	10.0		1507	11.5
	2132	0.3		2200	-1.2
12	0331	8.5	27	0422	9.3
TU	0937	3.2	W	1013	3.1
	1505	9.8		1558	10.8
	2211	0.6		2251	-0.5
13	0413	8.2	28	0520	9.0
W	1016	3.6	TH	1103	3.5
	1537	9.6		1700	10.1
	2253	1.0		2346	0.3
14	0501	7.9	29	0623	8.9
TH	1059	4.0	F	1209	3.8
	1619	9.3		1804	9.3
	2341	1.3			
15	0556	7.8	30	0042	1.0
F	1154	4.3	SA	0723	8.9
	1718	8.9		1314	3.8
				1915	8.8
			31	0141	1.5
			SU	0822	9.2
				1421	3.4
				2027	8.6

TIME MERIDIAN 120° W. 0000 IS MIDNIGHT. 1200 IS NOON.
HEIGHTS ARE RECKONED FROM THE DATUM OF SOUNDINGS ON CHARTS OF THE LOCALITY.

PORT TOWNSEND, WASHINGTON, 1976

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

SEPTEMBER

DAY	TIME H.M.	HT. FT.	DAY	TIME H.M.	HT. FT.
1	0313	-0.4	16	0253	0.8
W	1109	6.7	TH	1115	6.4
	1504	5.3		1459	5.5
	2058	7.5		2003	6.4
2	0420	-0.4	17	0352	0.7
TH	1226	7.0	F	1223	6.7
	1620	5.6		1613	5.7
	2205	7.2		2123	6.3
3	0529	-0.3	18	0451	0.7
F	1327	7.3	SA	1308	7.0
	1759	5.6		1730	5.4
	2318	7.0		2245	6.2
4	0634	-0.2	19	0548	0.6
SA	1413	7.5	SU	1347	7.3
	1942	5.1		1834	4.9
5	0031	6.9	20	0005	6.4
SU	0730	0.0	M	0644	0.6
	1455	7.7		1412	7.5
	2037	4.5		1927	4.2
6	0136	6.8	21	0111	6.7
M	0819	0.3	TU	0730	0.7
	1531	7.8		1441	7.7
	2113	3.9		2013	3.2
7	0235	6.8	22	0213	7.1
TU	0857	0.7	W	0820	1.0
	1559	7.7		1507	7.8
	2148	3.3		2055	2.2
8	0328	6.8	23	0313	7.5
W	0936	1.2	TH	0907	1.4
	1624	7.6		1536	7.9
	2213	2.7		2137	1.1
9	0418	6.8	24	0410	7.8
TH	1008	1.8	F	0949	2.1
	1651	7.5		1606	8.0
	2245	2.2		2223	0.2
10	0505	6.7	25	0509	7.9
F	1040	2.4	SA	1035	2.9
	1713	7.3		1638	8.1
	2317	1.8		2308	-0.6
11	0556	6.6	26	0608	8.0
SA	1115	3.0	SU	1120	3.7
	1737	7.2		1713	8.0
	2352	1.4		2354	-1.0
12	0645	6.5	27	0710	7.9
SU	1150	3.6	M	1209	4.4
	1800	7.0		1751	7.9
13	0031	1.1	28	0046	-1.1
M	0744	6.4	TU	0819	7.7
	1229	4.2		1301	5.0
	1825	6.9		1833	7.6
14	0112	0.9	29	0141	-0.9
TU	0845	6.3	W	0932	7.6
	1311	4.7		1400	5.5
	1854	6.7		1926	7.2
15	0202	0.9	30	0239	-0.5
W	1002	6.3	TH	1046	7.6
	1400	5.2		1518	5.6
	1921	6.6		2034	6.7

OCTOBER

DAY	TIME H.M.	HT. FT.	DAY	TIME H.M.	HT. FT.
1	0343	0.1	16	0258	0.8
F	1149	7.7	SA	1117	7.5
	1732	5.3		1614	5.5
	2157	6.3		2050	5.7
2	0449	0.6	17	0357	1.1
SA	1242	7.8	SU	1159	7.7
	1908	4.6		1728	4.9
	2329	6.1		2233	5.7
3	0557	1.1	18	0456	1.5
SU	1324	7.8	M	1231	7.8
	1953	3.9		1823	3.9
4	0049	6.2	19	0003	6.0
M	0654	1.6	TU	0552	1.9
	1403	7.8		1305	8.0
	2029	3.1		1909	2.8
5	0157	6.5	20	0119	6.5
TU	0746	2.1	W	0652	2.4
	1433	7.8		1333	8.1
	2057	2.4		1948	1.6
6	0254	6.7	21	0223	7.2
W	0828	2.6	TH	0742	2.9
	1459	7.7		1406	8.2
	2121	1.8		2030	0.4
7	0345	7.0	22	0326	7.8
TH	0907	3.1	F	0838	3.6
	1526	7.5		1438	8.4
	2143	1.3		2114	-0.7
8	0433	7.2	23	0421	8.4
F	0943	3.7	SA	0927	4.2
	1548	7.4		1513	8.4
	2212	0.8		2200	-1.5
9	0519	7.3	24	0520	8.7
SA	1015	4.1	SU	1017	4.8
	1611	7.2		1547	8.4
	2244	0.5		2243	-1.9
10	0601	7.4	25	0616	8.8
SU	1054	4.6	M	1108	5.3
	1633	7.1		1627	8.2
	2315	0.2		2331	-2.0
11	0646	7.4	26	0715	8.8
M	1129	5.0	TU	1200	5.7
	1656	6.9		1711	7.9
	2351	0.1			
12	0739	7.3	27	0020	-1.6
TU	1210	5.4	W	0811	8.7
	1713	6.8		1258	5.9
				1753	7.4
13	0033	0.2	28	0109	-1.0
W	0831	7.3	TH	0912	8.6
	1257	5.7		1411	5.9
	1721	6.6		1859	6.7
14	0117	0.3	29	0202	-0.2
TH	0930	7.3	F	1011	8.5
	1352	5.8		1634	5.5
	1718	6.4		2016	6.1
15	0205	0.5	30	0301	0.8
F	1027	7.4	SA	1101	8.4
	1459	5.8		1807	4.6
	1739	6.1		2155	5.6
			31	0357	1.7
			SU	1146	8.3
				1859	3.7
				2338	5.6

TIME MERIDIAN 120° W. 0000 IS MIDNIGHT. 1200 IS NOON.
HEIGHTS ARE RECKONED FROM THE DATUM OF SOUNDINGS ON CHARTS OF THE LOCALITY.

SAN FRANCISCO BAY ENTRANCE (GOLDEN GATE), CALIF., 1976

F-FLOOD, DIR. 066° TRUE   E-EBB, DIR. 245° TRUE

SEPTEMBER

DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS	DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS
1	0106	0405	3.0F	16	0057	0346	2.1F
W	0724	0932	2.0E	TH	0716	0920	1.6E
	1256	1550	2.3F		1236	1533	1.6F
	1847	2202	4.1E		1823	2144	3.2E
2	0218	0526	3.0F	17	0201	0455	2.2F
TH	0836	1045	1.8E	F	0820	1022	1.5E
	1414	1707	2.2F		1353	1642	1.6F
	1956	2311	4.0E		1929	2243	3.3E
3	0324	0637	3.2F	18	0259	0558	2.4F
F	0940	1206	1.9E	SA	0916	1123	1.8E
	1526	1821	2.4F		1502	1743	1.9F
	2104				2035	2342	3.5E
4		0021	4.0E	19	0351	0651	2.8F
SA	0423	0735	3.4F	SU	1005	1222	2.2E
	1035	1323	2.2E		1559	1841	2.3F
	1627	1924	2.7F		2136		
	2206						
5		0123	4.1E	20		0040	3.8E
SU	0514	0824	3.6F	M	0438	0736	3.2F
	1121	1412	2.6E		1048	1316	2.8E
	1720	2017	3.0F		1649	1938	2.8F
	2301				2233		
6		0216	4.2E	21		0132	4.1E
M	0559	0905	3.7F	TU	0522	0821	3.5F
	1202	1452	3.0E		1128	1402	3.4E
	1808	2106	3.2F		1735	2027	3.3F
	2352				2327		
7		0257	4.2E	22		0222	4.4E
TU	0640	0942	3.7F	W	0603	0859	3.8F
	1239	1523	3.3E		1205	1448	4.1E
	1851	2146	3.4F		1820	2115	3.8F
8	0038	0336	4.1E	23	0019	0309	4.5E
W	0717	1014	3.6F	TH	0644	0938	3.9F
	1313	1555	3.6E		1242	1533	4.6E
	1931	2225	3.4F		1906	2203	4.2F
9	0123	0411	3.9E	24	0112	0354	4.4E
TH	0752	1045	3.4F	F	0725	1018	4.0F
	1346	1628	3.7E		1319	1618	5.1E
	2010	2300	3.3F		1953	2251	4.4F
10	0205	0447	3.6E	25	0205	0443	4.1E
F	0826	1114	3.2F	SA	0807	1100	3.8F
	1417	1703	3.8E		1358	1703	5.3E
	2048	2339	3.2F		2042	2342	4.4F
11	0248	0522	3.3E	26	0300	0531	3.7E
SA	0858	1147	2.9F	SU	0850	1144	3.6F
	1448	1742	3.9E		1440	1750	5.3E
	2128				2136		
12		0017	3.0F	27		0036	4.2F
SU	0332	0603	2.9E	M	0358	0624	3.2E
	0930	1222	2.6F		0939	1233	3.2F
	1520	1823	3.8E		1526	1841	5.1E
	2210				2234		
13		0058	2.7F	28		0133	3.8F
M	0420	0645	2.5E	TU	0459	0717	2.7E
	1003	1301	2.3F		1033	1326	2.8F
	1554	1906	3.6E		1619	1937	4.7E
	2259				2337		
14		0149	2.5F	29		0236	3.5F
TU	0512	0732	2.1E	W	0603	0816	2.3E
	1041	1343	2.0F		1139	1429	2.4F
	1634	1953	3.5E		1720	2034	4.3E
	2355						
15		0244	2.2F	30	0044	0350	3.2F
W	0612	0823	1.8E	TH	0709	0922	2.0E
	1129	1436	1.7F		1254	1536	2.2F
	1723	2047	3.3E		1829	2139	3.9E

OCTOBER

DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS	DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS
1	0151	0504	3.1F	16	0108	0410	2.5F
F	0813	1038	2.0E	SA	0740	0953	1.9E
	1409	1655	2.1F		1329	1608	1.6F
	1941	2248	3.7E		1851	2206	3.4E
2	0255	0609	3.2F	17	0205	0504	2.7F
SA	0910	1206	2.2E	SU	0831	1052	2.3E
	1518	1812	2.4F		1436	1711	1.9F
	2050				2002	2306	3.4E
3		0002	3.5E	18	0259	0559	3.0F
SU	0352	0706	3.3F	M	0918	1146	2.8E
	1000	1305	2.6E		1533	1815	2.4F
	1616	1912	2.7F		2110		
	2153						
4		0106	3.5E	19		0005	3.6E
M	0443	0753	3.4F	TU	0349	0648	3.2F
	1043	1348	3.0E		1000	1241	3.4E
	1707	2007	3.0F		1624	1913	2.9F
	2249				2213		
5		0155	3.5E	20		0100	3.7E
TU	0528	0832	3.4F	W	0437	0734	3.5F
	1122	1423	3.3E		1041	1330	4.1E
	1752	2052	3.2F		1713	2005	3.5F
	2340				2312		
6		0236	3.4E	21		0152	3.8E
W	0608	0907	3.3F	TH	0523	0818	3.7F
	1158	1456	3.6E		1120	1417	4.8E
	1833	2131	3.4F		1800	2056	4.1F
7	0027	0310	3.3E	22	0009	0244	3.8E
TH	0646	0938	3.1F	F	0608	0903	3.7F
	1231	1524	3.9E		1200	1506	5.3E
	1911	2206	3.4F		1848	2147	4.4F
8	0111	0345	3.1E	23	0104	0335	3.7E
F	0721	1007	3.0F	SA	0654	0947	3.7F
	1303	1559	4.1E		1241	1551	5.6E
	1948	2244	3.4F		1937	2236	4.6F
9	0154	0421	2.9E	24	0200	0423	3.5E
SA	0754	1038	2.8F	SU	0740	1030	3.6F
	1334	1634	4.1E		1324	1638	5.7E
	2025	2320	3.3F		2028	2331	4.6F
10	0237	0500	2.7E	25	0255	0516	3.2E
SU	0826	1109	2.6F	M	0829	1119	3.3F
	1404	1711	4.2E		1411	1728	5.6E
	2103	2357	3.2F		2121		
11	0320	0539	2.5E	26		0024	4.4F
M	0658	1146	2.3F	TU	0351	0607	2.9E
	1436	1752	4.1E		0923	1212	3.0F
	2143				1501	1819	5.3E
					2217		
12		0039	3.0F	27		0121	4.1F
TU	0406	0622	2.2E	W	0449	0701	2.5E
	0932	1227	2.1F		1023	1308	2.6F
	1511	1834	3.9E		1558	1914	4.8E
	2227				2317		
13		0123	2.7F	28		0222	3.7F
W	0456	0709	2.0E	TH	0548	0802	2.3E
	1013	1314	1.8F		1132	1411	2.3F
	1551	1921	3.7E		1700	2015	4.3E
	2316						
14		0216	2.6F	29	0018	0330	3.5F
TH	0549	0758	1.8E	F	0646	0906	2.2E
	1106	1403	1.6F		1245	1522	2.1F
	1640	2012	3.5E		1810	2116	3.7E
15	0011	0313	2.5F	30	0120	0435	3.3F
F	0645	0854	1.8E	SA	0742	1020	2.3E
	1215	1502	1.6F		1357	1642	2.1F
	1741	2109	3.4E		1921	2222	3.3E
				31	0219	0536	3.2F
				SU	0833	1137	2.6E
					1502	1756	2.3F
					2030	2329	3.0E

TIME MERIDIAN 120° W. 0000 IS MIDNIGHT. 1200 IS NOON.

STRAIT OF JUAN DE FUCA ENTRANCE, 1976

F-FLOOD, DIR. 115° TRUE E-EBB, DIR. 290° TRUE

SEPTEMBER DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS	DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS	OCTOBER DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS	DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS
1 W	0508 1023	0043 0740 1354 *1922	1.9E 0.8F 1.1E *	16 TH	0509 0947	0024 0723 1348 *1906	1.4E 0.4F 0.9E *	1 F	0544 1110	0129 0823 1500 *2041	1.6E 0.8F 1.2E *	16 SA	0505 1010	0037 0738 1420 *1955	1.3E 0.5F 1.1E *
2 TH	0616 1140	0154 0853 1518 *2044	1.8E 0.8F 1.1E *	17 F	0608 1056	0123 0827 1500 *2020	1.4E 0.5F 0.9E *	2 SA	0654 1210	0245 0932 1605 *2156	1.5E 0.6F 1.4E *	17 SU	0607 1103	0145 0837 1516 *2109	1.3E 0.5F 1.2E *
3 F	0722 1250	0303 1001 1626 *2158	1.8E 0.8F 1.2E *	18 SA	0704 1200	0231 0929 1602 *2129	1.4E 0.5F 1.1E *	3 SU	0759 1302 2125	0354 1029 1658 2301	1.5E 0.7F 1.5E 0.3F	18 M	0707 1154	0257 0930 1605 *2214	1.3E 0.6F 1.4E *
4 SA	0822 1348	0411 1102 1727 *2303	1.8E 0.9F 1.3E *	19 SU	0754 1255	0333 1024 1651 *2232	1.4E 0.6F 1.2E *	4 M	0035 0857 1345 2158	0458 1121 1746 2352	1.5E 0.7F 1.6E 0.5F	19 TU	0803 1240 2108	0405 1024 1653 2306	1.3E 0.6F 1.7E 0.5F
5 SU	0915 1435 2225	0512 1151 1812	1.8E 0.9F 1.5E	20 M	0841 1341 2150	0436 1111 1732 2325	1.5E 0.7F 1.4E 0.3F	5 TU	0148 0948 1421 2230	0553 1204 1823	1.5E 0.7F 1.7E	20 W	0108 0855 1324 2137	0506 1112 1734 2355	1.4E 0.7F 1.9E 0.8F
6 M	0136 1003 1515 2300	0001 0607 1236 1855	0.3F 1.8E 0.9F 1.6E	21 TU	0102 0925 1422 2214	0527 1154 1813	1.6E 0.8F 1.6E	6 W	0247 1033 1452 2301	0039 0640 1243 1858	0.6F 1.5E 0.6F 1.8E	21 TH	0220 0945 1405 2212	0602 1156 1815	1.5E 0.7F 2.1E
7 TU	0238 1047 1548 2334	0050 0655 1318 1934	0.4F 1.8E 0.9F 1.6E	22 W	0214 1008 1500 2245	0013 0620 1235 1849	0.5F 1.7E 0.9F 1.8E	7 TH	0336 1116 1519 2332	0116 0723 1316 1931	0.7F 1.5E 0.5F 1.8E	22 F	0322 1034 1444 2250	0044 0651 1242 1856	1.0F 1.6E 0.7F 2.2E
8 W	0331 1129 1617	0133 0736 1355 2005	0.5F 1.7E 0.8F 1.7E	23 TH	0316 1052 1536 2320	0101 0705 1314 1930	0.8F 1.8E 0.9F 2.0E	8 F	0420 1157 1542	0156 0758 1350 2000	0.8F 1.4E 0.5F 1.8E	23 SA	0419 1124 1523 2332	0133 0743 1324 1937	1.2F 1.6E 0.6F 2.3E
9 TH	0008 0418 1208 1642	0213 0815 1424 2038	0.6F 1.6E 0.7F 1.7E	24 F	0414 1137 1611	0145 0752 1356 2008	1.0F 1.8E 0.9F 2.1E	9 SA	0003 0500 1239 1602	0227 0837 1420 2032	0.8F 1.4E 0.4F 1.8E	24 SU	0513 1217 1602	0219 0833 1413 2024	1.4F 1.6E 0.6F 2.4E
10 F	0042 0500 1247 1705	0249 0852 1457 2109	0.6F 1.5E 0.6F 1.7E	25 SA	0000 0509 1225 1646	0232 0843 1436 2049	1.1F 1.8E 0.8F 2.2E	10 SU	0035 0538 1324 1619	0304 0915 1454 2059	0.8F 1.3E 0.3F 1.8E	25 M	0017 0606 1314 1640	0308 0925 1458 2109	1.4F 1.6E 0.5F 2.3E
11 SA	0117 0541 1328 1725	0328 0930 1527 2141	0.6F 1.4E 0.5F 1.7E	26 SU	0044 0604 1317 1721	0321 0932 1521 2134	1.2F 1.7E 0.6F 2.2E	11 M	0108 0617	0337 0953 *1523 2130	0.8F 1.2E * 1.7E	26 TU	0105 0659 1420 1718	0356 1017 1551 2158	1.4F 1.5E 0.3F 2.1E
12 SU	0155 0621 1413 1744	0406 1009 1558 2215	0.6F 1.3E 0.3F 1.6E	27 M	0132 0700 1416 1756	0411 1025 1609 2223	1.2F 1.5E 0.5F 2.1E	12 TU	0145 0657	0417 1036 *1600 2203	0.8F 1.1E * 1.6E	27 W	0157 0751	0448 1117 *1647 2252	1.3F 1.4E * 1.9E
13 M	0235 0703	0445 1048 *1635 2252	0.5F 1.1E * 1.6E	28 TU	0226 0759 1528 1832	0507 1126 1701 2316	1.1F 1.4E 0.3F 2.0E	13 W	0225 0739	0500 1123 *1641 2246	0.7F 1.1E * 1.5E	28 TH	0254 0845	0543 1221 *1752 2355	1.1F 1.4E * 1.7E
14 TU	0321 0750	0533 1139 *1714 2333	0.5F 1.0E * 1.5E	29 W	0326 0901	0609 1232 *1803	1.0F 1.3E *	14 TH	0312 0825	0543 1216 *1735 2335	0.6F 1.0E * 1.4E	29 F	0358 0938	0643 1325 *1908	0.9F 1.4E *
15 W	0413 0844	0622 1241 *1803	0.4F 0.9E *	30 TH	0432 1005	0015 0715 1348 *1916	1.8E 0.9F 1.2E *	15 F	0405 0916	0636 1317 *1838	0.6F 1.0E *	30 SA	0507 1030	0103 0749 1433 2030	1.5E 0.8F 1.4E *
												31 SU	0619 1120	0219 0851 1533 *2141	1.3E 0.7F 1.5E *

TIME MERIDIAN 120° W. 0000 IS MIDNIGHT. 1200 IS NOON.
*CURRENT WEAK AND VARIABLE.

ADMIRALTY INLET (OFF BUSH PT.), WASH., 1976

F-FLOOD, DIR. 180° TRUE   E-EBB, DIR. 005° TRUE

SEPTEMBER

DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS	DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS
1		0112	3.3E	16		0052	2.3E
W	0512	0809	2.0F	TH	0458	0755	1.3F
	1126	1426	1.7E		1103	1415	1.3E
	1750	1955	0.8F			*1935	*
	2154						
2		0221	3.1E	17		0153	2.2E
TH	0620	0924	2.0F	F	0558	0858	1.4F
	1242	1543	1.7E		1211	1531	1.4E
	1917	2111	0.6F			*2050	*
	2301						
3		0330	3.0E	18		0257	2.3E
F	0726	1031	2.1F	SA	0657	1001	1.5F
	1349	1656	1.9E		1311	1632	1.6E
	2032	2228	0.7F		2035	2201	0.3F
					2324		
4	0019	0441	3.0E	19		0405	2.4E
SA	0827	1132	2.3F	SU	0752	1054	1.7F
	1445	1755	2.1E		1400	1721	1.9E
	2130	2336	0.9F		2110	2304	0.6F
5	0134	0542	3.1E	20	0052	0507	2.6E
SU	0921	1221	2.4F	M	0843	1141	2.0F
	1530	1844	2.4E		1442	1804	2.3E
	2217				2142	2355	1.1F
6		0033	1.2F	21	0207	0557	2.8E
M	0241	0636	3.1E	TU	0930	1224	2.1F
	1009	1309	2.4F		1519	1843	2.7E
	1609	1925	2.6E		2216		
	2258						
7		0118	1.4F	22		0044	1.6F
TU	0338	0725	3.0E	W	0312	0648	3.0E
	1053	1346	2.3F		1015	1305	2.2F
	1642	2005	2.8E		1553	1921	3.1E
	2336				2251		
8		0159	1.6F	23		0130	2.0F
W	0429	0806	2.9E	TH	0411	0736	3.1E
	1133	1420	2.2F		1100	1346	2.3F
	1711	2036	2.9E		1627	1957	3.5E
					2329		
9	0011	0242	1.7F	24		0216	2.4F
TH	0515	0844	2.8E	F	0507	0825	3.1E
	1210	1454	2.0F		1145	1423	2.2F
	1738	2109	3.0E		1701	2038	3.8E
10	0045	0317	1.7F	25	0011	0302	2.7F
F	0558	0923	2.6E	SA	0602	0911	3.0E
	1247	1526	1.7F		1232	1506	2.0F
	1802	2140	2.9E		1737	2121	3.9E
11	0119	0357	1.7F	26	0055	0352	2.9F
SA	0640	0959	2.3E	SU	0657	1002	2.6E
	1324	1557	1.5F		1322	1549	1.6F
	1826	2210	2.9E		1814	2204	3.9E
12	0154	0433	1.7F	27	0143	0443	2.8F
SU	0722	1039	2.1E	M	0754	1055	2.5E
	1405	1628	1.2F		1417	1636	1.4F
	1849	2245	2.8E		1854	2253	3.7E
13	0232	0514	1.6F	28	0236	0538	2.7F
M	0807	1120	1.8E	TU	0854	1156	2.2E
	1450	1703	0.9F		1521	1731	1.1F
	1913	2320	2.6E		1937	2346	3.4E
14	0315	0559	1.5F	29	0334	0639	2.4F
TU	0858	1209	1.6E	W	0958	1300	2.0E
	1545	1744	0.6F		1637	1833	0.8F
	1937				2028		
15		0003	2.5E	30		0048	3.1E
W	0403	0652	1.4F	TH	0438	0743	2.2F
	0957	1306	1.4E		1106	1415	1.9E
	1657	1833	0.4F		1804	1949	0.6F
	2005				2131		

OCTOBER

DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS	DAY	SLACK WATER TIME H.M.	MAXIMUM CURRENT TIME H.M.	VEL. KNOTS
1		0200	2.8E	16		0103	2.1E
F	0548	0855	2.1F	SA	0457	0806	1.6F
	1211	1530	2.0E		1120	1450	1.7E
	1925	2111	0.6F			*2025	*
	2254						
2		0315	2.6E	17		0212	2.0E
SA	0657	1002	2.0F	SU	0559	0904	1.6F
	1310	1633	2.2E		1211	1548	2.0E
	2027	2224	0.8F		2003	2137	0.4F
					2311		
3	0024	0425	2.5E	18		0327	2.0E
SU	0801	1100	2.0F	M	0702	1002	1.7F
	1400	1729	2.5E		1258	1637	2.3E
	2115	2333	1.1F		2034	2241	0.9F
4	0144	0528	2.5E	19	0050	0437	2.2E
M	0858	1153	1.9F	TU	0801	1054	1.7F
	1442	1818	2.7E		1340	1719	2.8E
	2156				2107	2336	1.4F
5		0024	1.4F	20	0208	0536	2.4E
TU	0251	0623	2.5E	W	0856	1139	1.8F
	0949	1236	1.9F		1420	1801	3.2E
	1518	1853	2.9E		2143		
	2233						
6		0106	1.7F	21		0026	2.0F
W	0346	0712	2.5E	TH	0315	0630	2.6E
	1034	1311	1.8F		0949	1227	1.9F
	1549	1928	3.1E		1458	1843	3.7E
	2306				2221		
7		0148	1.9F	22		0114	2.6F
TH	0434	0751	2.5E	F	0415	0723	2.7E
	1115	1346	1.6F		1039	1309	1.8F
	1616	2000	3.1E		1536	1925	4.0E
	2338				2301		
8		0222	2.0F	23		0202	3.0F
F	0517	0831	2.4E	SA	0510	0812	2.8E
	1154	1421	1.4F		1130	1356	1.8F
	1641	2030	3.1E		1615	2009	4.2E
					2344		
9	0009	0257	2.1F	24		0246	3.3F
SA	0557	0906	2.3E	SU	0604	0903	2.8E
	1233	1450	1.2F		1222	1439	1.6F
	1705	2100	3.1E		1655	2052	4.2E
10	0039	0333	2.1F	25	0029	0335	3.4F
SU	0636	0945	2.1E	M	0657	0955	2.7E
	1313	1520	1.0F		1316	1527	1.4F
	1728	2131	3.0E		1736	2139	4.1E
11	0111	0408	2.1F	26	0117	0424	3.3F
M	0715	1021	2.0E	TU	0750	1049	2.5E
	1356	1555	0.8F		1416	1616	1.1F
	1750	2200	2.9E		1819	2229	3.8E
12	0146	0443	2.0F	27	0208	0518	3.0F
TU	0757	1103	1.8E	W	0845	1147	2.3E
	1446	1630	0.6F		1524	1718	0.8F
	1811	2235	2.7E		1907	2324	3.[illegible]E
13	0224	0524	1.9F	28	0304	0615	2.7F
W	0842	1151	1.7E	TH	0940	1251	2.2E
	1547	1712	0.3F		1642	1822	0.6F
	1834	2316	2.5E		2003		
14	0308	0613	1.8F	29		0022	2.9E
TH	0931	1245	1.6E	F	0405	0717	2.4F
		*1801	*		1036	1356	2.2E
					1803	1939	0.5F
					2115		
15		0007	2.3E	30		0136	2.4E
F	0359	0707	1.7F	SA	0510	0818	2.1F
	1025	1349	1.6E		1131	1503	2.3E
		*1904	*		1913	2102	0.6F
					2248		
				31		0251	2.1E
				SU	0619	0922	1.3F
					1221	1601	2.5E
					2008	2213	0.9F

TIME MERIDIAN 120° W. 0000 IS MIDNIGHT. 1200 IS NOON.
*CURRENT WEAK AND VARIABLE.

APPENDIX F

CATENARY DATA FOR ITT CABLE AND COMMUNICATIONS CABLE

CODE FPO-1C3

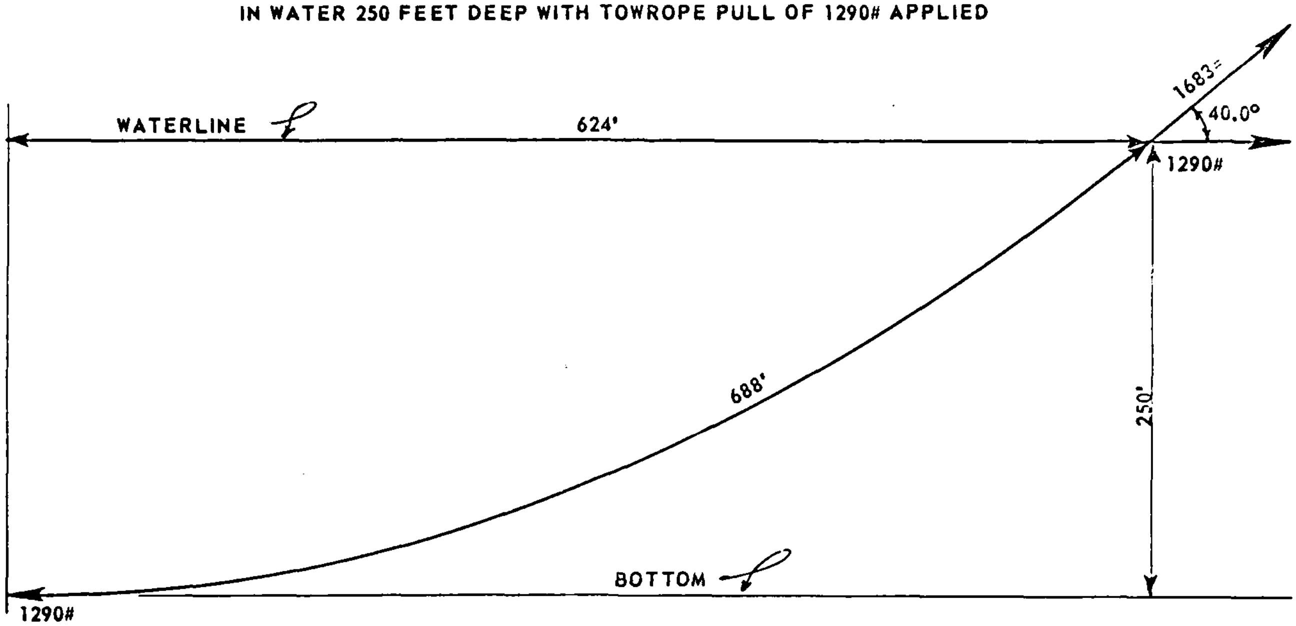
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
WASHINGTON, D. C. 20374

During the cable-laying activities in the 13th Coast Guard District, two different types of cable will be used and will be installed in water depths down to 300 feet. The allowable tension in the cable during the laying operations is established by the strength of the cable splices on one hand and the load limit of the cable machine on the other. The estimated maximum load at dead pull should not exceed 5,000 pounds tension in either case. At the suggested 1.5 knot towing speed the available towrope pull should be on the order of 1290 pounds.

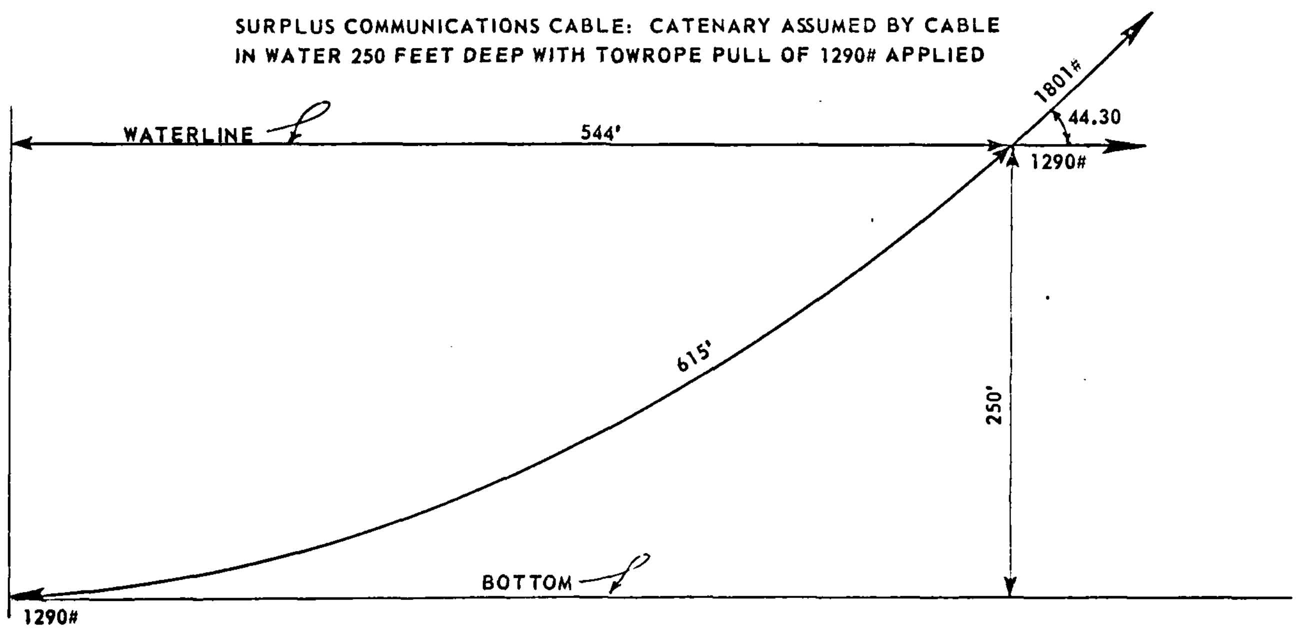
Since there will be neither a towrope pull nor a cable tension measuring device available for this operation, the only way to estimate the tension in the cable during these operations is to observe the angle made by the cable with the water surface at the point of entry. This has been designated as the *lead-off angle*; it is equivalent to the arc cosine of the horizontal force (or towrope pull) divided by the cable tension. The cable tension is equal to the towrope pull plus the weight of the cable suspended from the surface. The latter is a function of the weight of cable per unit length in water (1.571 #/ft for the ITT cable and 2.045 #/ft for the communications cable) and the water depth.

In Figure F-1 the catenary configuration, dimensions, and forces for equivalent depth and towrope pull conditions are illustrated for each of the cables. Figures F-2 and F-3 are working curves that give the cable tension and the towrope pull for the ITT cable as functions of the lead-off angle and water depth. Figures F-4 and F-5 provide similar working information for the surplus communications cable. After the towing speeds and control elements have been established for each operation; the target lead-off angles can be derived.

ITT POWER CABLE: CATENARY ASSUMED BY CABLE
IN WATER 250 FEET DEEP WITH TOWROPE PULL OF 1290# APPLIED



SURPLUS COMMUNICATIONS CABLE: CATENARY ASSUMED BY CABLE
IN WATER 250 FEET DEEP WITH TOWROPE PULL OF 1290# APPLIED

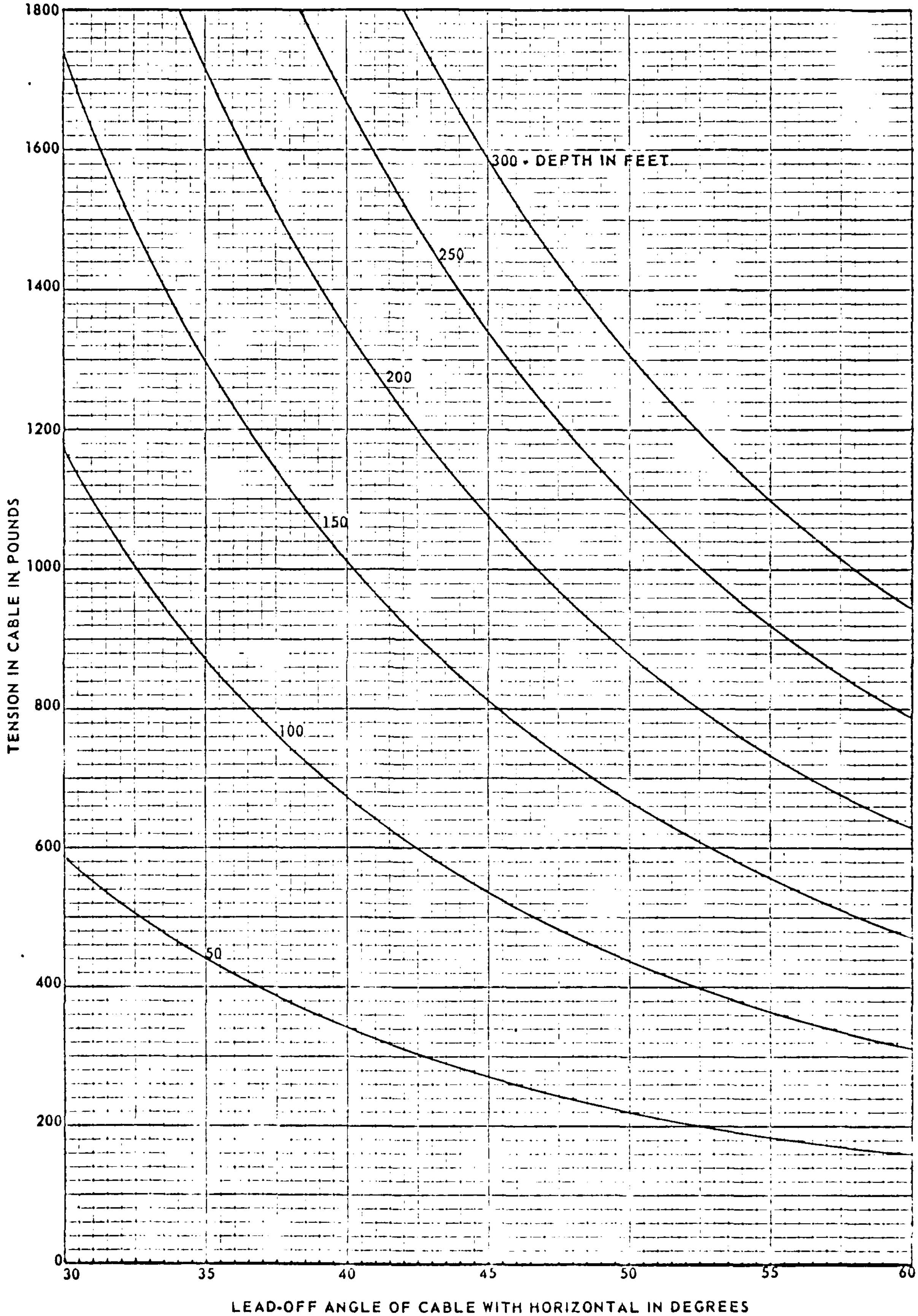


CABLE CATENARIES FOR ITT POWER CABLE AND
SURPLUS COMMUNICATIONS CABLE UNDER IDENTICAL
CONDITIONS OF WATER DEPTH AND TOWROPE PULL

FIGURE F-1

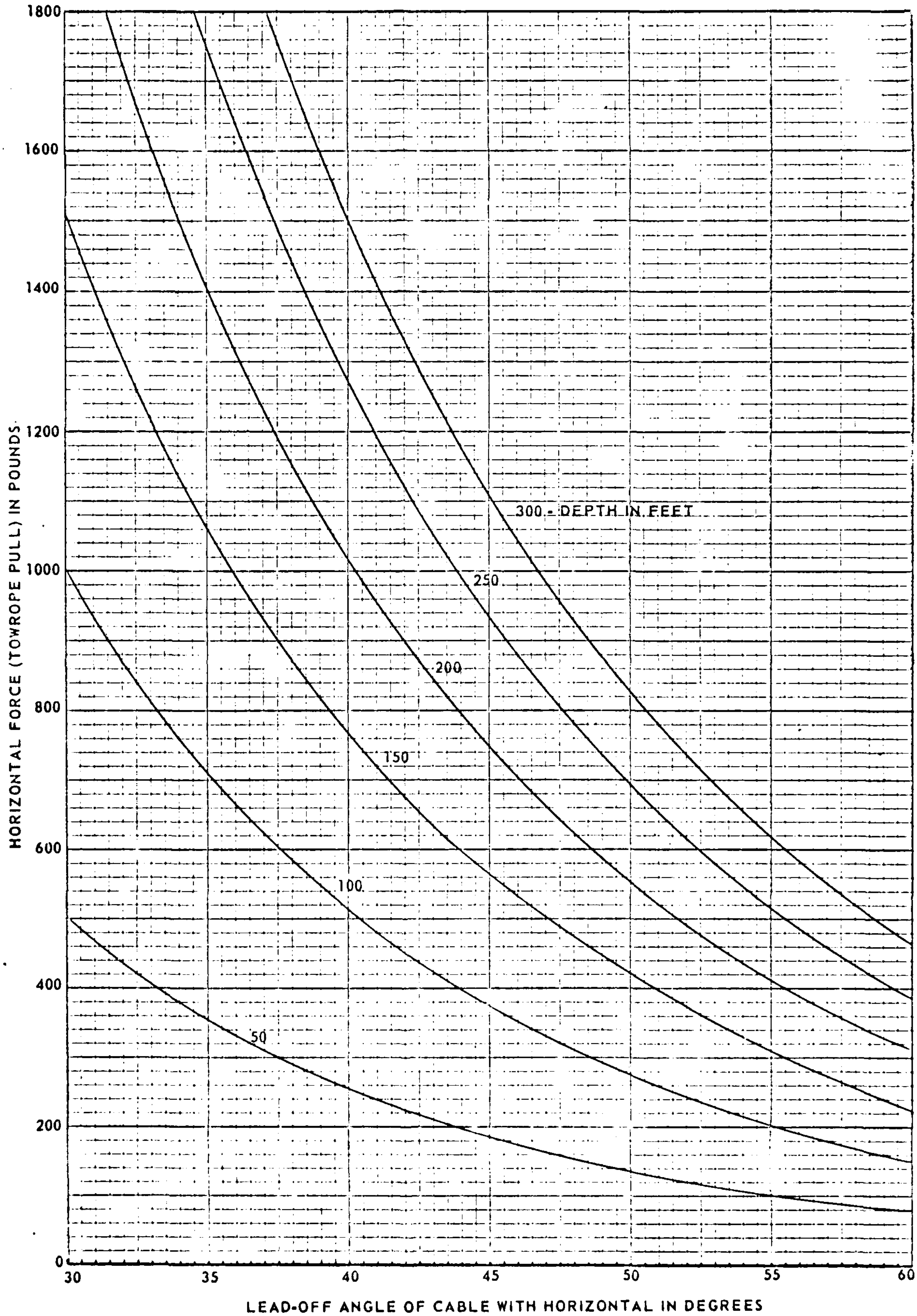
ITT POWER CABLE: CABLE TENSION VERSUS LEAD-OFF ANGLE

FIGURE F-2



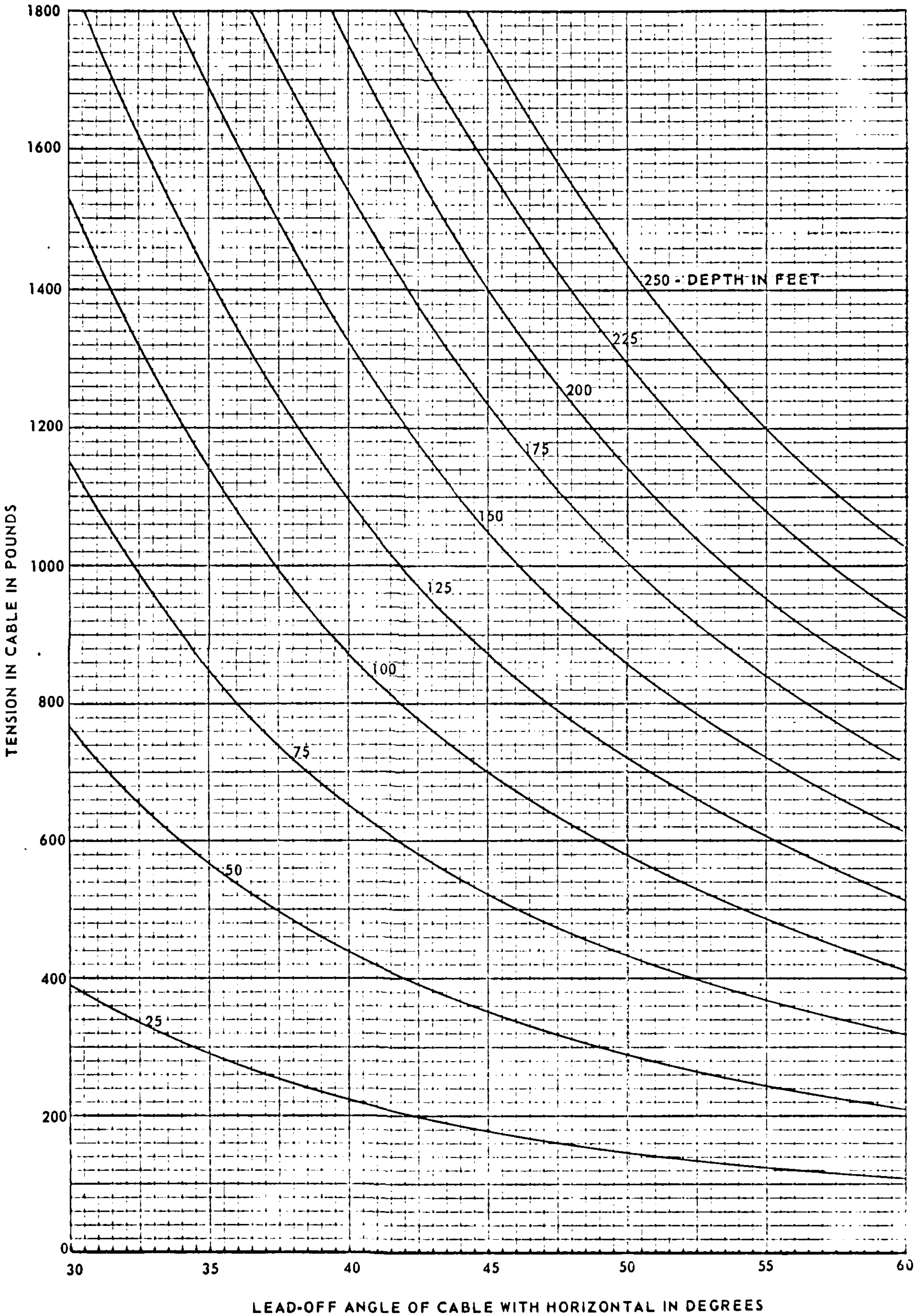
ITT POWER CABLE: HORIZONTAL FORCE TO MAINTAIN CABLE TENSION

FIGURE F-3



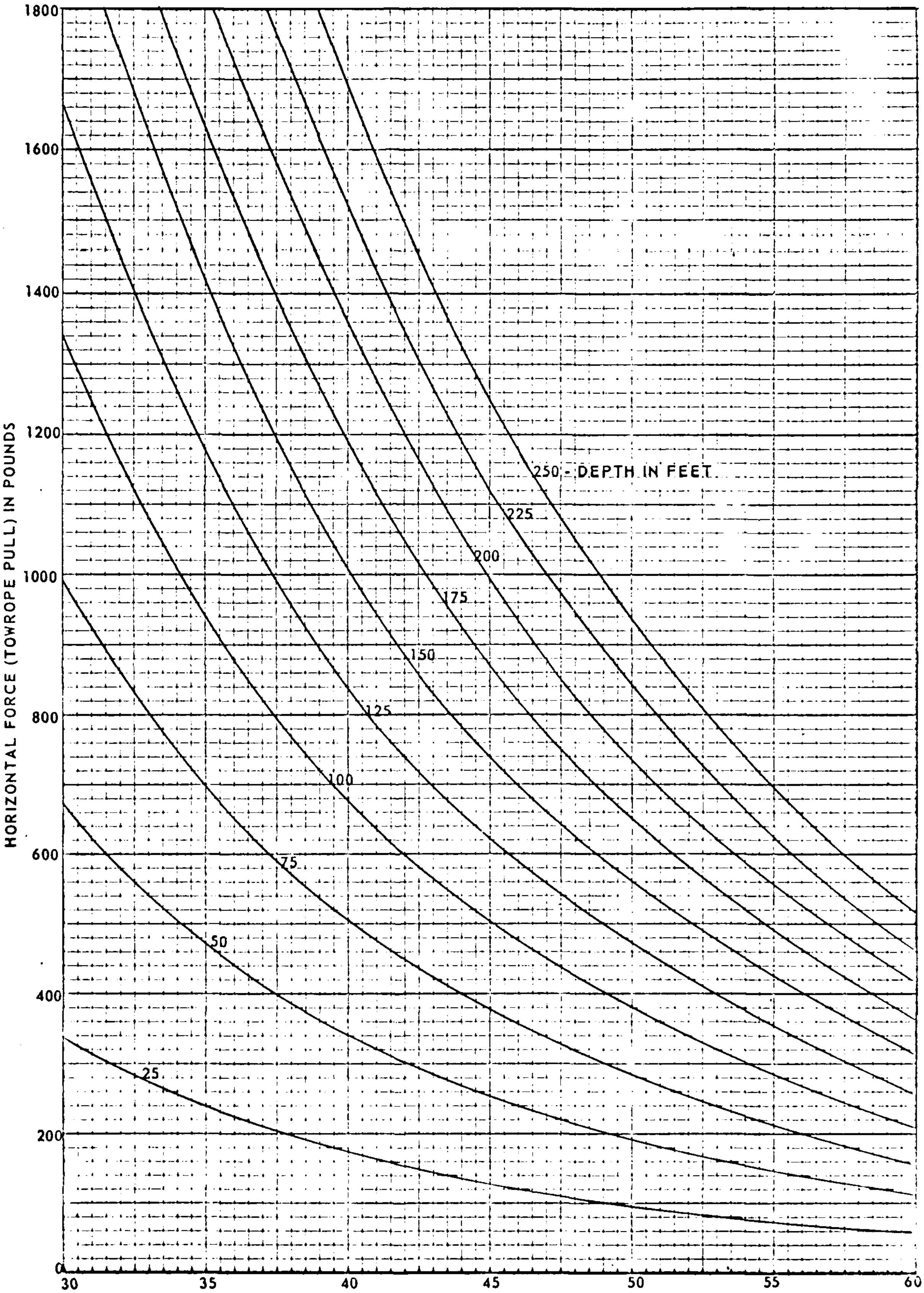
SURPLUS COMMUNICATIONS CABLE: CABLE TENSION VERSUS LEAD-OFF ANGLE

FIGURE F-4



SURPLUS COMMUNICATIONS CABLE: HORIZONTAL FORCE TO MAINTAIN TENSION

FIGURE F-5



LEAD-OFF ANGLE OF CABLE WITH HORIZONTAL IN DEGREES

APPENDIX G

MISCELLANEOUS EQUIPMENT AND REQUIREMENTS LIST

CODE FPO-1C3

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
WASHINGTON, D. C. 20374

The following list is not a total list of all detail equipment and requirements for the three principal organizations involved. Each organization will be expected to supply the equipment necessary to accomplish the tasks as outlined in the Project Execution Plan. The list is intended as a supplemental guide for certain specific requirements.

CHESNAVFACENGCOM

- Mini-Ranger System: Console, 3 transponders, spares, electrical leads and cables, batteries, battery leads, and straps. (This system may be supplied by the 13th Coast Guard District from the NOAA field survey office in Seattle.)
- Navigation Kit and Tools: Navigation charts.
- Four (4) Coast Guard COMCO "walkie-talkie" radios.

UCT-2

- LARC V and ZODIAC plus gear and equipment to operate.
- Extra split pipe sections and hardware, rock bolts for entire project, 600' of fire hose for split pipe filler.
- Cable float bags (50 each), lift bags (2 each)
- Portable depth recorder system plus three rolls recording paper
- Three surveyor's transits plus three tripods
- Assorted line for LARC and ZODIAC, for tying cable float bags, and for other requirements.

13th COAST GUARD DISTRICT

- YC-1092 barge on loan from the Naval Torpedo Station, Keyport, Washington.
- CLAMM, cable chutes (2 each), cable brake, cable stayed fairlead frame.
- Ladders (2 each) for boarding barge (ladders to extend one foot below barge bottom for diver use).
- Timber (2 x 6 and 2 x 4) for constructing cable bin, approximately 60 - 4' x 8' sheets of 1/2" plywood for cable layer separators, plus spare plywood sheets (6 each) for use as shore site markers.
- International orange spray paint cans (10 each).
- Spare full reels of surplus communications cable (2 each).
- Empty reels (4 each) for unused cable.
- 250 pound concrete clump anchors with eyes (16 each) plus 60 pound anchors (2 each Mushroom, Danforth, and Grapnel).

- 1,200 feet of 1" Nylon mooring line.
- Main cable fairlead block plus miscellaneous snatch blocks (6 each).
- Barge running lights (navigation lights), deck floodlights, plus generator and/or battery power.
- Electrical cable testing equipment (fault locating device and Megger); cable ends on barge to be left exposed for testing.
- 82' Coast Guard cutter; 42' (or equivalent) SAR boat; TICWAN boat.
- Trucks or vehicles on shore for cable hauling.

END